COLLEGE STUDENT MENTAL HEALTH: CURRENT ISSUES, CHALLENGES, AND A RANDOMIZED PILOT TRIAL OF A TECHNOLOGY-BASED INTERVENTION

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Abstract

Client demands for mental health services in institutions of higher education have grown dramatically. College students are at higher risk of developing mental illnesses such as depression, anxiety disorders, and alcohol and drug abuse. A student's psychological well-being plays an important role in their academic performance. Currently, campus mental health services face numerous challenges to increase capacity and provide adequate support for students. In a time of great technological advancement, recent research has found positive results in technology-based programs for psychological assessment and treatment. This dissertation reviews current issues, needs, and challenges of mental health service in higher education. It implemented a randomized pilot trial utilizing an approach called *ecological momentary assessment* to unveil hidden stress, depression, and anxiety among college students via a smart phone application. In addition, it examines a text message intervention that promotes physical activities to alleviate psychological stress, anxiety, and depression among participants in response to their busy academic workload. Participants were randomized into a basic or augmented group and received check in prompts via their smartphone applications at various time-points throughout the study period. In addition to the check-in prompts, the augmented group also received exercise promotion text messages every other day throughout the semester. Results found that participants had significant improvements overall in depressive ($p < .001$), anxious ($p < .001$), and stress ($p < .001$) symptoms. These changes did not differ between the basic and augmented groups ($ps > .05$). Overall, psychological assessment delivered via smartphone and a text message intervention for exercise promotion are feasible and acceptable among college-aged participants. Future research could expand

on content development and potentially lead to a full-service mental health application that promotes positive mental health and well-being within the entire student body.

Key words: college student mental health, mental health technology, physical activities, ecological momentary assessment

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Executive Summary

The prevalence of mental health problems among college students has been rising. College is a time with elevated risk for illnesses such as depression, anxiety disorders, and alcohol and drug abuse. These illnesses disrupt an individual's ability to function, learn, work, or participate fully in all areas of life. The increasing rate of psychiatric symptoms among college students places a larger burden on campus health services. Despite rapid changes in the past decade, campus mental health support and methods for providing services remained unchanged. Recent increase in demand for mental health services sparked a fear among college administrators, who now seek innovative approaches that are more easily accessible by the college population and increase capacity.

In a time of great technological advances, recent research has found positive results using technology-based programs for psychological assessment and treatment (Andersson & Cuijpers, 2009). Online interventions offer flexible tools for students to obtain support anytime and anywhere. Traditional campus mental health systems treat students who are physically present at the service center. Many are reluctant to go because they are afraid of being seen by their peers or the stigma related to mental illnesses in general (Eisenberg, Downs, Golberstein, & Zivin, 2009a). Online self-help technology provides a substitute for highly stressed and untreated students who do not speak up or seek help on their own out of fear of social stigmas or scheduling difficulties due to a busy college career. The advantages of online self-help technology include convenience, anonymity, lower cost, and the ability to service to more students.

This dissertation implemented a randomized pilot trial utilizing an approach called "ecological momentary assessment" to unveil hidden stress, depression, and anxiety among college students via a smart phone application. In addition, it examined a text message intervention that promotes physical activity as a means to alleviate psychological stress, anxiety, and depression students may experience in response to their academic workload. Regular physical activity can mitigate risks of psychiatric disorders and promote long-term physical and mental health. Research has shown that during stressful times, increasing exercise buffers the adverse effects of stress (Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). This study examined the feasibility, acceptability, and preliminary efficacy of using a smartphone application to monitor daily affect and encourage physical activity in college students. The goal is to increase the efficacy, efficiency, and capacity of campus mental health support.

Eight college students enrolled in the program, and 41 completed and met the minimum compliance score of 60. At the baseline and close of study, participants reported depressive, anxious, and stress symptoms. An ecological momentary assessment of daily affect and physical activity was conducted periodically during the study. Participants randomized to the augmented group received exercise promotion text messages every other day throughout the semester, while participants in the basic group did not. The messages involved themes shown to be correlated with regular activity and positive behavior changes (e.g. goal-setting and implementation intentions) and used language identified by college focus groups as likely to be helpful and well received.

Participants did not differ significantly in their daily mood and emotions throughout the three time-points of the study. On average, participants' daily affect

stayed about the same at the beginning of the semester, around midterm, and before the final exam period. Mixed ANOVA analyses were used to assess group differences in depressive, anxious, and stress-related symptoms. Overall, participants had significant improvements in depressive ($p < .001$), anxious ($p < .001$), and stress ($p < .001$) symptoms. These changes did not differ between the basic and augmented groups (ps $> .05$). Furthermore, neither group reported increased exercise frequency ($p > .05$). Multiple linear regression analysis did not find exercise to be a significant predictor of depression, anxiety, or stress.

In fighting mental illnesses, students face stigma and barriers in accessing treatment and support. Currently, campus health centers have limited resources to increase capacity and meet student needs. Mental health problems are learning problems that need to be better recognized on campuses. Today's students are "digital natives," and it would be a natural progression for them to receive mental health support via technology-based channels (Palmer, 2015). This dissertation reviews current students' mental health issues and the challenges and feasibility of incorporating technology-based mental health interventions on campus. Findings suggest that participants experienced moderate levels of depression, anxiety, and stress prior to start of the study. Psychological assessment delivered via smartphone app and a text message intervention for exercise promotion are feasible and acceptable among participants.

Chapter One: Introduction of Problem of Practice

Over the past 30 years, TV news, radio programs, newspapers and magazines have noted an increase in suicides and mental health problems on school campuses (Mowbray et al., 2006). Public attention and press coverage on the psychological well-being of the younger generation has grown, especially in college undergraduates (Mowbray et al., 2006). This is not simply a "perceived increase" in mental health problems on college campuses. A number of studies investigated heightened psychopathology and symptom severity among students (Arehart-Treichel, 2002; Watkins, Hunt, & Eisenberg, 2012). According to recent research, suicide is the second leading cause of death among college students (Drum, Brownson, Burton Denmark, & Smith, 2009). A large-scale study of 47,202 students from 74 colleges revealed that 14.9% of students were diagnosed with depression, 25.2% were in therapy, 38% took medication for depression, 15% suffered from clinical depression, 10% seriously contemplated suicide, and nearly half of the participants reported they had trouble functioning throughout their four-year college career (Fisher, 2004). As a result of maladaptive coping with stress or emotion management, increased use of alcohol and other substances has been observed on campus leading to an attention-worthy number of students developing substance abuse disorders or addiction (Giancola, Grawitch, & Borchert, 2009).

The U.S. Surgeon General's report on mental health stated, "Americans are inundated with messages about success—in school, in a profession, in parenting, in relationships—without appreciating that successful performance rests on a foundation of mental health" (US Department of Health Human Services, 1999). Academic success in

higher education is highly correlated with student mental health (Richardson, Abraham, & Bond, 2012). Psychological illness disrupts an individual's ability to function, learn, work, or participate fully in all areas of life. Recognizing and understanding the state of students' mental health can lead to better academic performance, and it can reduce or eliminate the consequences of poor psychological well-being later in life.

Higher education aims to prepare students with adequate skills and the necessary workforce knowledge for career advancement. Students with mental health issues experience poor academic performance and an inability to complete assignments and projects, which can eventually lead to dropping out of school (Bean, 1985; Richardson et al., 2012). Not completing college can result in unemployment and financial stress, which can worsen one's mental health. Even those with mental illness who manage to complete their college degree face difficulties in their early work experiences (Hinkelman & Luzzo, 2007). They are less productive and are absent from work more frequently due to poor mental health. The potential economic and societal burden of the student mental health crisis is costly and requires immediate attention from higher education institutions.

Problem of Practice

To remedy the "mental health crisis" higher education institutions face today, it is important to understand common mental symptoms and challenges among students and their experience with psychological distress. This chapter explores common mental health issues experienced by college students and the drivers that contribute to heightened mental health problems suggested by past research. The following research questions guide this chapter:

1. What are the common mental health issues college students face?

2. What are the underlying factors related to the current mental health crisis among college students?

Common Mental Health Issues Among College Students

The top five mental health problems that most frequently affect students are anxiety, depression, alcohol and other drugs, trauma, and eating disorders (Stock & Levine, 2017).

Anxiety

The term anxiety covers a broad range of symptoms. When worry or fear starts to interfere with one's life for a long period of time, an anxiety disorder is diagnosed. It covers a range of subcategories. For example, students with social anxiety disorders fear public speaking or interacting with others, preventing them from engaging with campus communities or, in more serious cases, leaving their dorm room. Panic disorder, another subcategory of anxiety, occurs when one experiences sudden and intense fear without provocation, along with physical symptoms such as rapid heartbeat, sweating, chest pain, and/or feelings of choking. Generalized anxiety disorder is commonly found among college students (Stock & Levine, 2017), and symptoms include constant worry and concern about academic performance, family, finances, and/or health, although the student has a lack of obvious reasons to worry. Researchers suggested several causes of high anxiety found among college students. Students face numerous demands on university campuses—personal, academic, financial, and interpersonal (Ross, Niebling, & Heckert, 1999). Changes in social activities, new responsibilities, and living with strangers creates additional stress for college students in comparison to the general public (Ross et al., 1999).

Depression

Depression is currently the number two mental illness among college students, and approximately 9% of college-aged adults have depression (Stock & Levine, 2017).The National Collegiate Health Assessment (NCHA) by the American College Health Association found that 33% of participating students felt so depressed they were unable to function, and 62% reported feeling "very sad" at least once in the past year (American College Health Association, 2013). It is common for one to feel sadness or "depressed" when a negative event happens, such as the death of a family member, unemployment, or the breakup of a relationship. Formal diagnosis of depression occurs when sadness or low mood persists for two weeks or longer (American Psychiatric Association, 2013). Depression severely disables an individual from normal daily functioning. Common symptoms seen among students include an inability to engage in normal social activities, not attending classes and work, sleeping a lot, loss of appetite, and overeating. As a result, students in a depressive episode perform poorly academically (Richardson et al., 2012). Some may even drop out of school or impose risks on themselves or others.

Substance Abuse and Addiction

Controlling illegal alcohol and drug use has been a challenge in the general U.S. population. It is common for students to start using alcohol and/or drugs during college, but some end up developing substance abuse or addiction issues and use alcohol and drugs to cope with negative mood and emotions. Based on the most recent National College Health Assessment Survey, two-thirds of participating students reported using alcohol at least once in the preceding year (American College Health Association, 2014).

Among those students, 22% reported consuming seven or more drinks in one sitting at least once, and 53% reported regret or guilt related to their alcohol use (American College Health Association, 2014). Substance abuse has a negative impact on the user and other campus members and extended communities (Stock & Levine, 2017). Research has shown an increase in universities related arrests due to liquor, drugs and murder (Arehart-Treichel, 2002).

Trauma Response

Posttraumatic Stress Disorder (PTSD) is a severe anxiety disorder that can develop after exposure to a trauma (American Psychiatric Association, 2013). The disorder is characterized by re-experiencing, avoidance, and hyperarousal symptoms leading to heightened distress in an individual (American Psychiatric Association, 2013). When an individual is in a dangerous situation, fear is a natural and healthy response. However, after a dangerous situation occurs, one may continue experiencing serious distress for weeks or months. PTSD can result from a variety of traumatic situations such as sexual assault, combat, rape, natural disasters, car accidents, or a harmful event that happened to someone else. Depending on the campus and nature of the student body, students' exposure to trauma and the type of trauma varies widely (Stock & Levine, 2017). For example, students who grew up in low-income neighborhoods are more likely to come to campus with prior trauma histories. Previous experience with traumatic events is a risk factor and increases the chances a student will develop PTSD. Furthermore, some schools are in areas with higher crime rates, increasing a student's chance of exposure to violent events and getting PTSD.

Eating Disorders

Bulimia and anorexia, along with body image issues, are prevalent on school campuses, especially among female students (Zivin, Eisenberg, Gollust, & Golberstein, 2009). These problems can seriously damage students and the campus communities. Eating disorders have the highest mortality rate of all mental disorders (Sullivan, 1995), and have high comorbidity with borderline personality disorder, depression, and anxiety disorders. Severe symptoms impair functioning in a student's academic performance. Additionally, recent studies found a growing trend towards males exhibiting eating disorders and body dysmorphia (Pope, Phillips, & Olivardia, 2000). Male students were less likely to seek professional help for these disorders (Davies et al., 2000). School clinicians and therapists have become quite familiar with treating females, and little investigation has been done regarding male students and eating disorders. The instruments used are specifically for assessing eating disorders among women.

The National Collegiate Health Assessment (NCHA) by the American College Health Association (ACHA) provides evidence for the increasing dysfunction and distress of the general population of college students (American College Health Association, 2013). Table 1.1 summarizes reports of distress and dysfunction from students.

Table 1.1

Student Reports of Distress and Dysfunction

Reported Symptoms	Percentage
Felt overwhelming anxiety	51.0%
Felt things were hopeless	44.8%
Felt overwhelming anger	36.3%
Felt so depressed that it was difficult to function	31.1%
Seriously considered suicide	7.4%
Intentionally cut, burned, bruised, or otherwise injured themselves	6.0%
Were in an emotionally abusive intimate relationship	9.25%

Source: American College Health Association, 2013

Furthermore, the ACHA (2013) found the top 10 reasons for poor academic performance were almost all related to psychological distress (Table 1.2).

Table 1.2

Top Issues Affecting Student Academic Performance

Issues	Percentage
Stress	28.25%
Anxiety	19.65%
Sleep difficulties	19.45%
Cold/flu/sore throat	14.1%
Work	13.9%
Depression	13.3%
Internet use/computer games	11.3%
Concern for a troubled friend or family member	10.2%
Relationship difficulty	9.15%
Participation in extracurricular activities (e.g., campus clubs, organizations, and athletics)	9.1%

Source: American College Health Association, 2013

Drivers of the Mental Health Crisis Among College Students

College is a time of elevated risk for depressive and anxious disorders due to the transitional nature of college life (Towbes & Cohen, 1996). Current findings in the

literature reflect several factors increasing the risk of today's college student population to develop mental illnesses: increased stress, unspoken symptoms, and poor mental health awareness.

Increased Stress

Today's student population shows greater levels of stress and anxiety throughout their college careers (Carter, Golant, & Cade, 2010). As students are away from home for the first time, they must adjust to new social environments while maintaining a high level of academic achievement (Ross et al., 1999). The Student Stress Survey (SSS) conducted among 100 college students found that the top five sources of stressors are change in sleeping habits, vacations/breaks, change in eating habits, new responsibilities, and increased class workload (Ross et al., 1999). These are followed by financial difficulties and changes in social activities (Ross et al., 1999). This generation of students faces unstable economic conditions, unemployment, cuts to government financial aid, raises in tuition rates, and a competitive job market, in addition to the stress of college life (Carter et al., 2010).

The transition from high school to college is quite stressful to those who grew up with overprotective parents. College students experience more pressure from society and parents to become high achievers (Watkins et al., 2012). Based on a qualitative study conducted by Watkins et al. (2011), much of the stress originated from "hovering, nervous, anxious, and too involved helicopter-type parents" who are living up to social pressure. Many students struggle with societal expectations combined with high expectations to succeed from demanding parents.

Hidden Mental Health Symptoms

Past research suggests a great portion of psychological difficulties among students remains unspoken. Stigma remains a major barrier in seeking help regarding mental health. Students are at higher risk if they experience mental dysfunction and remain in the dark, leading to maladaptive coping, substance use, full blown psychiatric episodes, or, in more serious cases, suicide. Zivin, Eisenberg, Gollust, and Golberstein (2009) conducted a longitudinal survey study measuring the symptoms of mental disorders, self-injury, and suicidal ideation of students attending college. Data were collected at baseline and two years later. Results at baseline found over 50% of the students had one mental health problem, and 60% had one mental health problem two years later at follow up (Zivin et al., 2009). The high prevalence of mental disorders found among students was alarming. The results also suggested that while some students were aware of the need for treatment, many do not take action or seek help (Zivin et al., 2009). Not speaking up or seeking support put them at a higher risk to develop complications, chronic illnesses, or life-threatening situations.

Poor Mental Health Awareness.

Students experience increasingly persistent levels of stress and anxiety. but are unaware of early signs of psychological dysfunction, which could be another possible driver for heightened mental health problems in college students. Early identification is the key to treatment of behavioral health problems. Not knowing the signs of mental dysfunction prevents students from obtaining the help and support they need early on. Efforts in the past suggested regular behavioral health screenings at campus primary care clinics to identify mental health problems and increase mental health awareness

(Shepardson & Funderburk, 2014). In a recent study, Shepardson and Funderburk (2014) proposed and tested a universal behavioral health screening test to facilitate the identification of early signs of psychiatric symptoms among students, promote help-seeking behavior, and increase access to treatment. The researchers distributed the screening questionnaire to a sample of 4,126 college students. Findings indicated a large number of mental health and mental health related problems among students, such as depression, suicidal ideation, alcohol misuse, smoking cessation, and sleep problems (Shepardson & Funderburk, 2014). Only a small percentage of the participants sought professional treatment (Shepardson & Funderburk, 2014).

Statement of the Problem and Project Objective

An individual's mental health acts as the foundation to physical health and daily functioning. Poor mental health has a significant impact on students' academic success (Eisenberg, Golberstein, & Hunt, 2009b). It is widely acknowledged in the field that the number of cases and the severity of psychiatric disorders among university students has increased (Carter et al., 2010; Watkins et al., 2012). Dramatic psychosocial changes have taken place in today's student population as well as an increase in academic pressure. Studies have shown college students are at an age associated with a high risk for the onset of psychiatric disorders (Kessler et al., 2005). Most mental illnesses manifest between the age of 18 and 25, and even if a student has not struggled with it in the past, it does not mean he or she will not face those struggles in college. It was found that post-secondary students are at higher risk for certain mental disorders than their non-college counterparts possibly due to increased stress, lifestyle changes, and inadequate support (Blanco et al., 2008).

It is impossible to eliminate life stressors, adversity, or increased academic pressure, but educators can promote healthy living and psychological well-being to help students cope. Leaders in higher education should not only make the college experience about learning and gaining knowledge from books, but also advance student success as whole people. It is unclear which exact mental health constructs leaders in higher education should target to prevent further development of today's student mental health crisis. Campus mental health support should develop early intervention, prevention, and resilience building to fight mental illnesses. Through this literature review, the next steps of the Problem of Practice will examine specific mental health constructs and their associations with student's academic performance.

Chapter Two: Needs Assessment

According to the 2013 National College Health Assessment (NCHA) conducted by the American College Health Association (ACHA), six of the ten leading factors negatively affecting student academic performance were related to mental health (American College Health Association, 2013). Those factors are stress, anxiety, sleep difficulties, depression, concern for a troubled friend or family member, and relationship difficulty. To gain further insight, Eisenberg et al. (2009) performed a detailed and descriptive analysis of the association between student academic outcomes and symptoms of mental illness among college students. They found depression is a significant predictor of lower GPA and indicates higher probability of dropping out. Anhedonia (lack of pleasure and interest in daily activities), a symptom of depression, is the strongest predictor of academic performance. In addition, anxiety and symptoms of eating disorders are negatively correlated with GPA.

Statement of Purpose

Problems with students' mental health have societal implications. The demand for mental health services and support in higher education institutions has grown dramatically. Leaders of higher education institutions have difficult decisions to make reagarding how to support their students in areas like strategic planning, implementation of new programs, and budget allocation. A bulk of research in the current literature examines student mental health and academic performance. Such studies focused mainly on clinical assessment of psychological symptoms and did not take other aspects of one's mental well-being into consideration (i.e. positive affect, self-perceived success, and personality).

Antaramian (2015) proposed a dual-factor mental health model to understand college student performance. Focusing solely on psychopathology is too narrow to assess the relationship between mental health and academic performance. A dual-factor mental health model includes positive mental health measures and symptom measures as an indication of one's mental health status (Antaramian, 2015). Using this dual-factor model, Antaramian (2015) found that individuals who have high subjective well-being and low levels of symptoms have the most favorable mental health profile for academic performance. Student's psychological well-being may be a causal interplay between a group of positive and negative measures, possibly through feedback loops. This needs assessment explores multiple aspects of college students' mental health (personality, depressive symptoms, loneliness, positive affect, negative affect, stress, and self-perceived success) and their associations with students' academic performance.

Three research questions guide the investigation:

1. Do university students have worse psychological well-being than the general population?
2. Are different measures of student's psychological well-being interconnected?
3. What is the impact of student mental health on academic performance?

This needs assessment study differs from previous work in many important dimensions. First, unlike many previous studies that recruited participants through on-campus mental health clinics, surveys were conducted in the general undergraduate and graduate population with the potential to include clinical and non-clinical populations. Second, unlike many epidemiological studies that only utilized data from school counseling centers focusing solely on clinical measures, the current study adapted six

validated self-reporting instruments that include clinical as well as positive and negative behavioral measures.

Method

Study Participants

The target population for the current needs assessment was full-time undergraduate and graduate university students, regardless of their utilization of on-campus counseling services. Participants could be healthy students without mental health issues. They could also be students seeking psychotherapy. All participants completed seven survey questionnaires. The current needs assessment utilized a pre-existing dataset from a large competitive private university. Forty-six full time university students were included in the dataset.

Variables

A student's GPA measured academic performance, and seven questionnaires related to psychological well-being were collected from each participant. The questionnaires dealt with personality, depressive symptoms, loneliness, positive affect, negative affect, stress, and self-perceived success. A brief description for each measure is listed below.

Big five personality traits. The Big Five personality traits are commonly used to describe personality using five broad domains: openness, conscientiousness, extraversion, agreeableness, and neuroticism. Empirical research has shown the five traits predict a varied range of human behaviors and are highly associated with an individual's psychological condition (Kotov, Gamez, Schmidt, & Watson, 2010).

Depression. Depression affects about 5% of the U.S. adult population in a given year, and it is a common reason for obtaining health care (Regier et al., 1993). Depression often coexists with other illnesses that may precede, follow, or cause it, and it is a high-risk factor for suicide. It is a widely-seen problem among university students and treated in campus counseling centers.

Loneliness. Students can often become homesick and lonely while away from home. Many experience emotional breakdowns caused by the sheer intensity of missing home. Not getting along with peers may increase the feeling of loneliness. Loneliness may be caused by emotional distress or result from other mental health issues.

Positive affect. Positive affect is defined as the feelings that reflect a level of pleasurable engagement with the environment (Clark, Watson, & Leeka, 1989). These feelings can be happiness, joy, excitement, enthusiasm, and contentment. In recent years, positive affect has been examined in association with a number of psychological constructs and health outcomes including self-esteem, extraversion, purpose, mastery, optimism, and symptoms of depression (Pressman & Cohen, 2005). In this needs assessment, positive affect is used as an emotions measure aimed to understand students' psychological well-being.

Negative affect. Negative affect refers to the feelings that reflect the experience of negative feelings within the environment (Clark et al., 1989). These emotions can be anger, contempt, disgust, guilt, and fear. Individuals in frequent states of calmness, confidence, and great enthusiasm usually exhibit low negative affectivity. In the current study, negative affect is used as an emotions measure aimed to understand students' psychological well-being.

Stress. It is normal for everyone to feel stress occasionally. Some people are better at coping with stress effectively, so they recover from it quicker than others. On the other hand, some individuals may suffer from chronic stress when the situation is overwhelming or when one cannot cope effectively. Long-term stress can have detrimental effects on mental and physical health, leading to illnesses like anxiety disorders and depression. Stress is commonly seen among university students. The current study explores student stress level and how it correlates with other measures.

Self-perceived success. Self-perceived success in areas such as relationships, self-esteem, purpose, and optimism is a new measure of an individual's well-being and psychological flourishing. It is important to explore this measure among university students because it helps educators understand their positive emotions and affective well-being. Measures of self-perceived success among students may be correlated with their academic performance, stress, and overall health condition.

Instruments

Six pre-existing measures were used to assess students' overall mental health. Participants self-reported on the following questionnaires and their cumulative grade point average (CGPA).

Patient Health Questionnaire (PHQ-9). Patient Health Questionnaire (PHQ-9), validated by Kroenke, Spitzer, and Williams (2001), is a widely used self-report screening tool for depression. It consists of 10 questions related to depressive symptoms on a 4-point Likert scale from "not at all" to "nearly every day" (Kroenke, Spitzer, & Williams, 2001).

UCLA Loneliness Scale. The UCLA Loneliness Scale is used to measure a participant's loneliness. It was developed and validated by Dr. Russell in 1996. Results indicated high reliability and test-retest reliability (r = .73). The questionnaire has 20 questions on a 4-point Likert scale ranging from "I often feel this way" to "I never feel this way."

Positive and Negative Affect Schedule (PANAS). Positive and Negative Affect Schedule (PANAS) is used to measure students' positive and negative affect. Watson, Lee, and Auke (1988) developed and validated the scales. Participants rate 20 words based on the intensity of their feelings toward each word on a scale from "very slightly or not at all" to "extremely."

Perceived Stress Scale (PSS). Perceived Stress Scale, developed by Cohen, Kamarck and Mermelstein (1983), is a self-report measure assessing an individual's stress level. It contains 10 questions on a 5-point Likert scale from "never" to "very often." It is widely used in clinical psychological research as a screening tool for high stress populations.

Big Five Personality Self-Description Inventory. Big Five Personality Self-Description Inventory is a self-report inventory designed to measure the Big Five Personality dimensions using 44 items. Participants label characteristics that may apply to them on a 5-point scale from "disagree strongly" to "agree strongly." This inventory is the most commonly used measure in personality research.

Flourishing Scale. The Flourishing Scale is used to measure students' self-perceived success. It is a brief 8-item summary measure on a 7-point Likert scale that covers important areas such as relationships, self-esteem, purpose, and optimism. This

newly developed measure, validated by Diener and colleague (2009), provides a single psychological well-being score on self-perceived success.

Data Source

This needs assessment was a self-reporting questionnaire design and analyzed a pre-existing dataset from Dartmouth University collected in 2013 (Wang et al., 2014). It was the first study that collected ecological momentary assessment (EMA) data from the cell phone applications of a group of active university students. The goal was to predict students' CGPA based on behavioral and psychological assessments. The participants installed an app on their phone that acted like an electronic diary. It collected information on their mental health conditions, academic performance, and behavioral trends. For the purpose of this needs assessment, the current study only utilized the baseline survey questionnaires and students' CGPA.

Analysis Plan

A descriptive analysis of the instruments was used to compare the current student sample with previous findings on the general population. For example, a higher average score among the current student sample on the PSS would indicate the students are more stressed than the general population. A correlation analysis was used to investigate correlations among the seven measures and how they interconnect with one another to impact one's overall mental health. Finally, a simple linear regression analysis was performed to analyze if any of the seven measures were significant predictors of student's academic performance (measured by CGPA).

Results

The results section is organized by research questions and includes the key findings and data highlights from the three statistical analyses: descriptive statistical analysis, correlation analysis, and simple linear regression.

Research Question One

Descriptive statistics of the mean and standard deviation of each of the seven measures can be found in Table 2.1. The current sample reported lower positive affect than the general population, 20.02 versus 29.7 (Cohen & Janicki-Deverts, 2012). As discussed earlier, positive affect reflects a level of pleasurable engagement with the environment. These positive feelings include happiness, joy, excitement, enthusiasm, and contentment. Lower positive affect was shown to have a high correlation with depression (Forbes & Dahl, 2005). This was also proven in the current sample. Patient Health Questionnaire (PHQ-9) was used to measure depression with a recommended cut-off score of 10 (Manea, Gilbody, & McMillan, 2012). Individuals who score higher than 10 on PHQ-9 are identified to have probable depression (Manea et al., 2012). Seventeen percent, or 8 out of 46 participants, scored 10 or higher on PHQ-9 in the current sample, meaning they were diagnosed with probable depression based on PHQ-9. In addition, this sample was shown to suffer from much higher stress levels than the general population. The Perceived Stress Scale (PSS) of the general population had a female average of 12.1 and a male average of 13.7 (Cohen et al., 1983). The current sample had a mean of 18.2. Past research studies mainly focused on clinical populations. The current study, recruiting from the general student population, revealed that university students suffered from high depression rates and levels of stress.

Table 2.1

Descriptive Statistics of Instruments (n=46)

	M	*SD*
Patient Health Questionnaire	5.52	4.61
UCLA Loneliness Scale	34.39	4.12
Positive and Negative Affect Schedule – positive affect	20.02	4.67
Positive and Negative Affect Schedule – negative affect	17.92	4.63
Perceived Stress Scale	18.22	6.90
Flourishing Scale	42.81	8.56

Research Question Two

A correlation analysis found strong interconnections among the seven measures. Degrees of correlation between the measures were reported using the Pearson correlation, where r ($-1 \leq r \leq 1$) indicated the strength and direction of the correlation, and a significant correlation refers to a p-value less than 0.05. Agreeableness was significantly correlated with self-perceived success ($r = .302$). Conscientiousness was significantly correlated with self-perceived success, depression, stress, and loneliness ($r = .373$, $r = -.363$, $r = -.447$, $r = -.350$). Neuroticism had a significant correlation with self-perceived success, depression, and stress ($r = -.430$, $r = .470$, $r = .578$). Stress and depression were strongly correlated with self-perceived success ($r = -.388$, $r = -.528$). Stress and loneliness were correlated with depression ($r = .544$, $r = .313$). Altogether, these findings suggested mental health symptoms could be interconnected and re-enforce one another, meaning one condition could affect the others. For example, high levels of stress could lead to depression, increasing one's negative affect and decreasing self-perceived success. This might turn into a positive feedback loop, worsening symptoms of depression and stress.

Research Question Three

Results found that several measures were significant in predicting academic performance. Based on the simple linear regression analysis, four variables significantly predicted student's academic performance measured by CGPA (*ps* < .05): depression, negative affect, stress, and self-perceived success. Depression, negative affect, and stress had negative associations with CGPA. If students scored higher on these three measures, their CGPA was lower. On the other hand, self-perceived success had a positive relationship with CGPA, meaning if the student scored higher on self-perceived success, their CGPA was better.

Discussion

Results from this needs assessment provide great implications and insights in understanding mental health among college students. High levels of depression and stress were found among participants. The current sample collected data from the general student population, instead of focusing solely on the clinical population. Past research suggested much of the challenges and stresses of student life remain hidden. Consistent with past findings, high depression and stress levels were found. The current sample yields a 17% probable depression rate and 41% higher than average stress level.

In addition to clinical assessment, other measures related to one's psychological well-being were included in the analysis. Correlation analysis reported that personality traits played a role in student mental health. More specifically, agreeableness, consciousness, and neuroticism were correlated with depression, stress, self-perceived success and/or loneliness. Results also found interconnection between various aspects of students' psychological well-being. Stress and depression were strongly correlated with

self-perceived success. Stress and loneliness had significant correlations with depression. Findings support the dual-factor mental health model proposed by Antaramian (2015) and highlight the potential validity of using this approach to evaluating student mental health. In the past, too much focus was on clinical assessment for the diagnosis of mental disorders. To understand the origin or the target issues of mental health conditions and take preventative measures among the general student population, factors related to psychological well-being, such as personality traits and positive and negative affects, should be taken into consideration for evaluation. Counseling centers may consider including additional measures related to psychological well-being instead of focusing on clinical symptoms.

Consistent with past research, this needs assessment found poor mental health had a significantly negative impact on students' academic performance. Depression, stress, and negative affect had strong negative associations with students' CGPA. This finding agreed with previous reports in the literature (American College Health Association, 2013; Ross et al., 1999). Eisenberg and colleagues (2009) reported depression as a significant predictor of lower GPA and higher probability of dropping out of school.

From a student's perspective, good mental health and academic success lead to human capital accumulation, which has positive consequences in their economic growth and helps secure significantly higher lifetime earnings. Beyond the individual student perspective, the impact of poor mental health among college graduates has devastating consequences on higher education institutions. Poor mental health students will result in decreases in retention and higher dropout rates leading to lost tuition, fees, and alumni donations. From an employer's perspective, graduates with poor mental health may have

inadequate performance when entering the workforce, which will also have a negative impact on the school's reputation.

Conclusion

This needs assessment found higher stress and depression levels among participants and provided some initial understanding of multiple aspects of students' psychological well-being that potentially effect academic performance. It also provided evidence for the impact a student's mental health has on their academic performance. Findings from the needs assessment highlighted the complexity and variety of factors that constitutes a student's mental health. In the past, too much effort has been focused on clinical assessments, neglecting other important aspects of well-being such as positive and negative affect. Most importantly, it highlights the fact that much of the stress and strain of the general student population is hidden. The results are used to develop more in-depth research on interventions to promote student mental health. It is important to determine how to best employ an effective intervention and achieve the greatest possible reach to those who do not speak up about their distress. The intervention needs to be easily embraced by the college-aged population rather than traditional, structural approaches.

Chapter Three: Intervention Literature Review

Evidence is abundant in supporting the high prevalence of psychological disorders on college campuses (American College Health Association, 2014; Rosenbaum & Liebert, 2015; Watkins et al., 2012). Common mental health problems among students are anxiety, depression, substance abuse, trauma, and eating disorders (American College Health Association, 2014). The top causes of mental distress and dysfunction reported by students are overwhelming anxiety, feeling hopeless, depressed, sad, angry, exhausted, considering suicide, loneliness, and involvement in an emotionally abusive relationship (American College Health Association, 2013). It is common for individuals to go through ups and downs and experience negative mood and emotions. When symptoms or negative affect persists for a long period of time and prevents a student from daily functions, he/she may develop mental disorders. Mental health is the foundation of learning. College students are at high risk for the development of mental disorders. A strategy to increase retention and academic performance is focusing on students healthy coping with stress, resilience to distress and overall psychological well-being (Douce & Keeling, 2014).

The needs assessment conducted on the current POP found high levels of depression and stress among the participants recruited from a private northeastern college: a 17% probable depression rate and 41% higher than average stress level. The majority of these participants did not speak up or seek treatment when they faced psychological difficulties and distress. Evidence from the needs assessment also showed that poor mental health had a significantly negative impact on students' academic performance. Depression, stress, and negative affect were negatively correlated with

students' cumulative grade point average (CGPA). Guided by Antaramian's dual-factor mental health model (2015), in addition to symptomatology, other measures of one's psychological well-being, such as positive and negative affect, should also be assessed.

Consistent with previous research and findings in the field, the needs assessment supported the significant impact of student mental health on academic performance (Richardson et al., 2012). Most importantly it found that much of the stress and strain of students' mental health remains unspoken and hidden. In reality, school leaders, faculty, campus staff, clinicians know little about their students outside of the classroom (Wang et al., 2014). Traditional approaches in campus mental health services were inadequate for understanding students' daily affect, mental health needs, and reaching out to and supporting all students who need help (Palmer, 2015; Ryan, Shochet, & Stallman, 2010). Furthermore, a focus on developing prevention programs is needed (Durlak & Wells, 1997). Students need effective and accessible services that support and engage distressed students to help build resilience and promote healthy coping; especially those who are less likely to seek help due to stigma or related reasons (Eisenberg et al., 2009a; Hunt & Eisenberg, 2010).

In a time of great technological advances, recent research has found efficacious results from technology-based programs to make psychological assessment and treatment methods that could potentially benefit students and campus counseling centers (Lintvedt, S⊘ rensen, Østvik, Verplanken, & Wang, 2008; Mailey et al., 2010). Online interventions offer flexible tools for students to obtain self-help and support anytime and anywhere. Traditional campus health services provide students with information and treatment by being physically present at the clinic. Many are reluctant to go because they are afraid of

being seen by their peers or the general stigma associated with mental health (Hunt & Eisenberg, 2010). Others may be unaware of services or insurance coverage (Eisenberg, Golberstein, & Gollust, 2007). Online self-help interventions provide a substitute for highly stressed and untreated students who do not speak up or seek help for fear of social stigma or scheduling difficulties during a busy college career (Mailey et al., 2010). Counseling centers face major challenges in meeting students' needs, such as being short of staff, limited accessibility to services and support, and helping students to overcome stigma (Mowbray et al., 2006). Interventions delivered online could reduce the demand for in-person one-on-one sessions and group therapy, as well as alleviate scheduling difficulties and stigma, while also increasing their efficiency and capacity (Mailey et al., 2010).

This literature review examines the current inadequacies and challenges faced by campus mental health services. In searching for a solution to address these issues, it reviews a fast-growing body of literature on self-help interventions for students delivered via smartphone applications and online. It expands on current findings and suggests a potential approach to psychological surveillance and mood monitoring. In addition, this chapter examines physical activity as a powerful and cost-effective tool to building resilience as well as preventing and treating depression, anxiety, and stress, while promoting positive changes in students' mental health, physical health, and overall wellbeing.

Challenges Faced by Campus Mental Health Services

School leaders have difficult decisions to make to utilize limited resources and provide maximum support for students. A significant increase in campus client demands

has been well documented over the past 15 to 20 years (Benton, Robertson, Tseng, Newton, & Benton, 2003). Yet despite rapid changes, campus services and treatment of delivery remain the same. There are multiple challenges in making improvements to the current system.

Short Staffed.

Campus clinicians and health providers are the first to acknowledge reported symptoms from students and are highly involved in the treatment process (Watkins et al., 2012). They are the most important players in student mental health improvement. A study done on ten college counseling and mental health centers reported growing demands for student treatment (Watkins et al., 2012). Currently, maintaining the proper professional-to-student ratio is a major struggle (Benton et al., 2003). Budget shortage is the leading cause for not maintaining the proper ratio (Gallagher, 2012; Watkins et al., 2012). Counseling centers reported an increase in the severity of symptoms, and they are seeing an overall difference in psychosocial development in today's college student population (Watkins et al., 2012). Hence professional training becomes another challenge in addition to inadequate staffing needs. Educators know very little about the behaviors and emotions of their students outside of class (Wang et al., 2014). Much of their stress is hidden. With the current inadequate professional-to-student ratio in most counseling centers across the nation, students' needs remain poorly understood.

Accessing Services and Support

Research has suggested several potential obstacles preventing students from accessing service and support. The most cited barriers to seeking treatment were time, preference to manage problems on their own, lack of convenient access, and concerns

about confidentiality (Stock & Levine, 2017). Many students reported they simply do not know how to seek treatment (Eisenberg et al., 2007). Among students with positive screens for anxiety or depression, another research found the predictors for not receiving services are a lack of perceived need, being unaware of services or insurance coverage, skepticism about treatment effectiveness, low socioeconomic background, and being Asian or Pacific Islander.

The Internet is quickly becoming a main source for health information (Ryan et al., 2010). Students are more active online compared to older generations, and findings suggest students seek resources available to them primarily through their school's website (Palmer, 2015). However mental health websites are often poorly designed and lack important information (McKinley & Wright, 2012). Research has shown the Internet is a great place to put mental health resources, particularly for the younger generation who are more active online (Palmer, 2015). It is also a promising venue to offer mental health support through a peer-to-peer approach, while providing confidentiality and anonymity. Online resources and support have been shown to be effective in reducing stigma and increasing accessibility and capacity (Andersson & Cuijpers, 2009). Institutions of higher education should better utilize online technology to expand services and support for students.

Student Attitudes Towards Help-seeking.

Students' fear of stigma remains the number one barrier when it comes to accessing mental health services on campus (Eisenberg et al., 2009a). Understanding students' attitudes and behaviors towards mental health treatment can help productively address their needs. A bulk of literature investigates the barrier, attitudes, and beliefs

among university students towards seeking professional treatment (Davies et al., 2000; Eisenberg et al., 2007; Hunt & Eisenberg, 2010; Miller, Yang, Hui, Choi, & Lim, 2011). Fear of stigma prevents students from disclosing psychiatric symptoms and diagnoses, therefore preventing them from obtaining support and accommodation from their school, which can affect academic performance (Eisenberg et al., 2009a; Eisenberg, Golberstein, & Hunt, 2009c). Student services in higher education aim to promote positive attitudes towards professional mental health treatment (Benton et al., 2003). However, a large majority of student mental health issues go undiagnosed and untreated (Eisenberg, Speer, & Hunt, 2012). The fact that students are still fighting with stigma associated with mental disorders is very concerning. The current effort to fight stigma showed limited results (Eisenberg et al., 2009a). Stigma is embedded in societal values, and it is impossible to build a school culture without outside forces. Administrators need to advocate for better solutions to increase students' awareness of psychological problems and encourage them to seek treatment.

Inadequate Support System.

The Americans With Disabilities Act (ADA) protects people with mental illness and prevents discrimination against those who suffer from mental illness (Association for University and College Counseling Center Directors, 2012). As outlined by the American Disabilities Act, academic institutions are required to provide reasonable academic accommodations to students with psychiatric disabilities. Past findings illustrated that many students are not aware of their rights and campus resources (Yorgason, Linville, & Zitzman, 2008). Some mentally distressed students are not aware of campus resources or do not know how gain access to those services (Yorgason et al., 2008). In a survey report

on the mental health of college students, 38% of participants reported they were unaware of accommodations (Gruttadaro & Crudo, 2012). Students also complained the Disability Resource Center did not understand how to accommodate their mental health condition (Gruttadaro & Crudo, 2012).

One of the top reasons students found campus support systems inadequate is the disconnect between faculty and others involved in student care (Yorgason et al., 2008). The disability office is a separate entity from mental health services. If a student is seeking accommodation he/she needs to go to mental health services first to obtain proof, then file separately with the disability office and his/her professors, both of which involve tons of paperwork and forms. Students often get confused or are embarrassed to go through such a complicated process regarding their mental health. Past research also suggested faculty members did not recognize warning signs or symptoms of psychological crisis, making it difficult to provide support or assistance to their students (Brockelman & Scheyett, 2015). Many suggested policies that should inform and offer training for faculty and staff to learn facts about mental health (Gruttadaro & Crudo, 2012). National Alliance on Mental Illness (2006) surveyed college students, asking "What do you want faculty and staff to know about mental health?" The top five responses were general education on mental health conditions, how to support students, how to communicate with students, mental health conditions are real, and students can be successful with accommodations (Gruttadaro & Crudo, 2012).

Past efforts have moved to create faculty involvement in mental health promotion, awareness, and crisis prevention. Mitchell et al. (2012) recruited faculty and staff members from various departments to develop mental health promotion programs in their

courses. In these programs designed by faculty members, students were encouraged to see connections between their academic performance and implications for mental health. Findings showed that through collaborative effort, faculty had a deeper understanding of mental health issues. They referred students to resources on campus and actively engaged in mental health programs and promotion. Professors and lecturers have direct contact with students' learning and activities on a daily basis. They may recognize and foresee symptoms and signs of mental illnesses. However, in real world practice, faculty members already have a lot on their schedule. There are potential benefits associated with training faculty on mental health and their involvement in fostering positive psychological outcomes for students, but continuous efforts were difficult to carry out due to time constraints. Alternatives are needed to increase mental health awareness among faculty members and increase communication with student mental health services.

Theoretical Framework: Mental Health Technology

In response to the high demands in mental health and the fight for social justice and equal opportunities for mental health services, an area of fast-growing research focuses on developing self-help interventions that are well-suited for digitization and mass distribution via channels like smartphone apps and web-based services (Andersson & Cuijpers, 2009; Heron & Smyth, 2010; Lintvedt et al., 2008). Recent results in mental health technology have shown good efficacy and effectiveness in treatment designed around innovative technologies and multimedia (Andersson & Cuijpers, 2009; Heron & Smyth, 2010; Lintvedt et al., 2008). A technology-based program is cost effective, convenient, reduces stigma and inhibition, and has the ability to integrate effective counseling methods such as cognitive behavioral therapy. In the field of college mental

health support, such methods of delivery have the potential to increase the capacity and accessibility of services to meet the increasing needs of students (Mailey et al., 2010). The service would be provided online, an environment where students comfortably communicate. The following literature review collectively provides evidence in the following areas to support the implementation of technology-based treatment interventions: targeting hidden stress, promoting students' help-seeking behaviors, increasing the capacity of service and support, improving treatment techniques, and introducing innovative techniques.

Target Non-help Seeking Population

Traditional mental health services were inadequate in reaching all students who need help (Ryan et al., 2010). Online interventions provide useful ways to engage psychologically distressed students who are unlikely to seek in-person treatment (Ryan et al., 2010). Findings suggested that students prefer to obtain health-related information on the Internet when they see initial signs of symptoms (Escoffery et al., 2005). In a survey study, nearly half of the students reported a need for support due to stress or other psychological problems, but only one-third sought professional help for their mental health needs (Escoffery et al., 2005). Fifty-seven percent of those needing help showed positive attitudes toward using an internet-based intervention (Escoffery et al., 2005). Fifty-three percent would like to get health information online, 28% would like to attend a health program online, 74% have ever received health information via the Internet, and more than 40% frequently searched online for health-related information (Escoffery et al., 2005).

The current generation lives in an era defined by self-service. People prefer ATMs and smartphones to banks, online shopping to brick-and-mortar stores, and Wikipedia to libraries. When younger generations get sick, they are more likely to visit WebMD.com or perform a quick Google search to understand their symptoms long before they reach the doors of a doctor's office. Online behavioral health screenings can facilitate early identification and treatment of behavioral health problems common among college students (Shepardson & Funderburk, 2014). An online screening program called eBridge is used to help college students with suicide risks and offers personalized feedback and optional online counseling (King et al., 2015). Students who used the eBridge intervention scored higher in readiness to seek professional help than students who did not use it (King et al., 2015). They also reported lower stigma levels, and were more likely to receive mental health treatment (King et al., 2015).

Easy Access to Service and Support.

Utilization of technology in mental health service makes information and support more assessable to students. School resources will be available to them in seconds, and it saves students many phone calls and trips to the service center. At the same time, it provides staff with a flexible tool allowing them to spend their working hours more effectively and improve the capacity to meet students' needs.

Lintvedt et al. (2013) evaluated the effectiveness and efficacy of an unguided internet-based self-help intervention to reduce depression severity among a sample of 163 students. The authors suggested that utilization of the Internet as a medium for delivering mental health interventions has many potential benefits such as its anonymity, improved capacity and accessibility of service, and increased availability to patients. The 163

student participants were randomized to the Internet intervention group or the control group. Results showed great compliance, effectiveness, and efficacy from the intervention group. Pre- and post-intervention assessment suggested the self-help program was effective in reducing symptoms of depression and negative automatic thoughts in the current sample. User satisfaction also yielded positive results in that 76.7% reported the intervention was easy to understand. Current student clients vary largely on their symptom severity. Some require immediate hospitalization, but some only experience symptoms without formal diagnosis. Online practices can serve as preventive mechanisms and provide targeted improvements in populations with less severe conditions so staff can spend their therapy time on students who present more severe symptoms. Self-help tools with on-campus clinicians in a more guiding role increase in treatment dosage and efficiency. It is a way to increase access and provide services that may not be sought by students.

Deliver Established Face-to-face Treatments Online.

Advances in mental health technology are continually being developed. The Internet offers a variety of multimedia interactivity and connectivity formats. Most importantly, online applications made it possible to convert the current face-to-face treatments to Internet-assisted services tailored to specific needs and interests of individual clients. There has been a growing effort for the introduction of such techniques in college mental health services, more specifically in CBT and ACT interventions.

Cognitive behavior treatment. Cognitive Behavior Treatment (CBT) is a well-established and effective therapy option demonstrated through research, clinical trials, and practices (Barlow, Raffa, & Cohen, 2002). Recent research has attempted to

computerize active components of CBT and design internet-based CBT programs (Botella et al., 2010). Botella and colleague (2010) explored a program called "Talk to Me" designed to help individuals who have a fear of public speaking. A sample of 127 socially anxious participants was randomly assigned to three experimental conditions: an internet-based CBT treatment group, an in-person CBT therapy group, and a waiting-list control group. Results found that both "Talk to Me" and the in-person CBT treatment delivered equally significant improvements among the participants based on their pretreatment to posttreatment measures. The combination of new technologies and self-help procedures delivers the same results as in-person sessions and has the potential to provide improvements in treatment efficacy and capacity.

Acceptance and commitment therapy. Acceptance and Commitment Therapy (ACT) has shown promising results in effectively treat student clients (Hayes, Pistorello, & Levin, 2012). Its key elements include acceptance, mindfulness, values, and commitment treatment components. ACT aims to reduce psychological inflexibility governed by psychological reactions.

Levin and colleagues (2015) examined a web-based adjunctive intervention with a design based on acceptance and commitment therapy to provide mental health support for college students. A total of 30 counselors and 82 students participated in the study. Participants completed three 30-45 minute highly engaging guided self-help lessons consistent with an ACT approach. The counselors performed an online training to familiarize themselves with the web-based program they used to provide guided self-help to students. Counselors monitored students' progress and responses in the self-help lessons. Results on program usage by students and counselors, program satisfaction, and

pre-to-post changes showed good feasibility and acceptability in treating a variety of problems with the current web-based self-help design. Findings support an online design for ACT to meet the needs of student clients. Multimedia has the potential to improve traditional techniques, while making ACT treatment highly interactive and personalized.

Ecological momentary assessment and intervention. Ecological momentary assessment (EMA) and intervention (EMI) is a fast-growing technology-based health behavior treatment technique that permits students to report their symptoms, emotions, and behaviors on smartphone applications close in time to when their experience happened (Heron & Smyth, 2010). The biggest advantage is its ability to assess and promote behavioral changes in real-time (Heron & Smyth, 2010). When a doctor analyzes a patient's physical symptoms, he can get an immediate response regarding heart rate, body temperature, posture, or pain. When patients are asked about their mental health conditions, the response tends to rely on retrospective questionnaires to measure how a patient's mood, anxiety, and emotion regulation tendencies are changing. Such assessments are vulnerable to memory errors and biases. Advancement in EMA/EMI gives the public, clinicians, and researchers new ways to access help, which increases understanding of psychological well-being in natural contexts and monitors progress.

Riordan and colleagues (2015) designed a brief ecological momentary intervention (EMI) application for smartphones aimed at reducing alcohol consumption in freshman students. The beginning of college is usually a difficult and stressful transition for many students. During orientation week, high consumption of alcohol among freshman students leads to more serious issues such as underage drinking, violence, and poor academic performance later in the semester or their college career.

Participants were randomly assigned to the EMI group or a control group. Students from the EMI group received text messages promoting positive behavior every night during orientation week. Although male students from the intervention group did not show much difference in drinking behavior, female students from the EMI group consumed significantly fewer drinks than those from the control group. Traditional psychological assessments do not infer how students' daily emotions and behaviors are changing and how to cope with the negative changes as they occur in real-time. This study presented promising results in promoting positive behaviors using EMI delivered on a smartphone application.

Theoretical Framework: Physical Activities and Mental Health

As indicated earlier, traditional approaches in treating student mental health problems suffer from an array of barriers such as stigma, availability, accessibility of care, and limited resources. An important focus of this Problem of Practice is to increase campus service capacity by reaching out to more students in distress. The invention in need must have the ability to serve large groups of students at low cost. The role of exercise in the physical health and well-being of an individual has been long established. Meta-analytic evidence suggests that physical activity can be effective in reducing depressive symptoms and states of anxiety (Craft & Landers, 1998; Petruzzello et al., 1991). Recently a great deal of research efforts shifted to identifying the possible benefits of physical exercise on mental health and psychological well-being (Ströhle, 2009).

Findings in health literature consistently suggest a physically active lifestyle effectively improves individual's fitness levels and overall health (Haskell et al., 2007; Pate et al., 1995). Physical activity (PA) is a protective factor for cardiovascular diseases,

hypertension, diabetes mellitus, osteoporosis, and some types of cancer (Haskell et al., 2007). Within the past few decades, an increasing number of studies focused on the effect of exercise training on depression, anxiety, and stress (Conn, 2010; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Petruzzello et al., 1991; Ströhle, 2009). In an earlier meta-analysis done by Petruzzello et al. (1991), results showed that exercise is associated with anxiety reduction. One study they looked at compared the potential stress-buffering effect of three health behaviors—physical activity, sleep quality, and snacking—among college students. Data showed that during stressful times, increasing exercise buffered adverse effects of stress on affect in young adults. The authors further suggest potential targets for health-promotion and stress-prevention programs include exercise, which could help reduce the negative impact of stress in college students.

Past studies have repeatedly reported the associated effects of PA as an antidepressant for depression and anxiety disorders. Findings consistently confirmed the positive effects of PA on depression and anxiety. The next section will review a large body of empirical evidence that suggests physical exercise plays a major role in the prevention and treatment of depression and anxiety disorders, two top common mental health issues found among college students, and the effectiveness of physical exercise in that role.

Anxiety Disorders

Numerous RCT and correlational studies have suggested significant effects of regular physical exercise in reducing anxiety. Herring et al. (2012) conducted a randomized controlled trial to test the feasibility of exercise training for treating generalized anxiety disorder (GAD). Thirty women were randomized to either of the two

exercise conditions or the control condition. At follow up, participants in the exercise conditions showed significant reductions in worry symptoms in comparison to control. Results strongly support the feasibility and effectiveness of exercise training as a potential low-risk treatment for GAD. The authors suggested that although findings are still preliminary and further investigations are needed, beneficial effects of exercise training on reducing participants' worry symptoms are promising (Herring et al., 2012).

In a review of the effects of exercise on anxiety and its disorders, Asmundson et al. (2013) examined past research that focused on the therapeutic effects of physical exercise among individuals with mood disorders. Specifically, they examined the mechanism for which exercise works as an effective treatment for anxiety disorders. From a physiological perspective, exercise provided physiological resilience when an individual experienced stressful situations. Physical exercise regulates negative psychological states when an individual experiences stress such as neuroendocrine adaptations, increases in body temperature, changes in central serotonergic systems, and increase in endorphin production.

In a similar review done in 2014, Szuhany and colleagues supported previous work and suggested exercise may serve as a cost-effective and accessible treatment for individuals suffering from anxiety disorders. Cross-sectional and longitudinal studies found evidence for a negative relationship between physical activity and psychiatric disorders. In other words, individuals who engaged in more exercise were shown to have lower rates of psychiatric disorders. Moreover, metal-analytic data showed individuals with psychiatric disorders would benefit from exercise interventions. In their review, the authors focused on mechanisms to promote physical exercise. They emphasized the

importance of motivation and maintenance in exercise interventions. Motivational strategies are applied to address barriers in initiating and maintaining an exercise routine. These consist of cognitive components, behavioral components, and interpersonal components. Maintenance refers to strategies that create a regular exercise routine to make it a habit such as reminders for exercise or putting exercise on the calendar as an appointment.

Depression

A study examining depression rates among college students found 44% of the sample reported depression symptoms (Gately, 2005). The needs assessment done on the current POP also found high depression scores among college students. Depressive symptoms severely disrupt one's daily functioning. Students with depression are at high risks of dropping out (DeBerard, Spielmans, & Julka, 2004). Evidence also suggests they are at greater risk to develop further psychiatric problems, like substance abuse, or, in more serious cases, suicide (Arehart-Treichel, 2002). Empirical evidence consistently supported the role of physical exercise as an effective method of intervention for depression among clinical and nonclinical populations (Barbour, Edenfield, & Blumenthal, 2007).

Pate et al (1995) conducted one of the most famous studies on exercise and health done in earlier years. The results suggested a dose of 17.5 kcal/kg per week as the public health recommendation for positive effects of exercise on health and wellness. By using such a dose, Dunn et al. (2005) found exercise was an effective treatment for alleviating mild to moderate major depression symptoms. Such results were replicated in adolescents and young adults. In a sample of 2,548 adolescents and young adults, researchers found

subjects who engaged in regular physical activity had significantly lower mental health problems than those who did not exercise (Ströhle, 2009). To validate the effects of exercise as a treatment for depression, Blumenthal et al. (2007) compared exercise with antidepressant medication and psychotherapy. Multiple studies reported the effectiveness of exercise was comparable to antidepressant medications. Additionally, exercise was found to be as effective as psychotherapy in several studies (Blumenthal et al., 2007). Depressed participants highly rate a combination of cognitive therapy and running.

Experimental studies were not the only studies that found the efficacy and effectiveness of physical exercise as a treatment for depression; rigorous meta-analytic data suggested the same. Recently, a large-scale meta-analysis provided evidence that exercise has high potential in treating depression without the side effects of antidepressants. It works well with individuals who are reluctant to go to psychotherapy or seek help due to stigma or lack of insurance. Rethorst et al. (2009) examined 58 randomized control trials on the effects of exercise and depressive symptoms that included 2,982 subjects (Rethorst, Wipfli, & Landers, 2009). Extremely strong support for clinical utility of exercise in the treatment of depression was found. Among those groups who engaged in physical exercise, significant improvement in depression symptoms were reported with a clinical success rate of between 67-74%.

The evidence obtained from past studies provides good empirical support that engagement in regular physical activity can prevent and alleviate psychiatric symptoms. Anxiety and depression are highly prevalent among college students. Physical exercise is cost effective and has the potential to lead to substantially greater physical and psychological health among students.

The Proposed Intervention

Intervention Overview

The proposed intervention is a smartphone application that assesses and monitors students' daily affect and uses physical activity promotion to potentially alleviate psychological difficulties students experience in response to their busy academic workload, such as stress, anxiety, and depression. Specific inputs of the invention are daily check-ins for emotions and physical activities, daily tips and tricks encouraging exercises, fitness classes and schedules, campus gym facility hours, exercise instructions with pictures (outdoor and indoor), activity log, gym tour and equipment orientation schedule, and strategies to overcome specific obstacles. These inputs are designed and delivered to students through a smartphone application.

Rationale of the Current Intervention

Recent innovative approaches in ecological momentary assessment (EMA) assesses psychological constructs in real-time, within the context of daily life has grown rapidly (Heron & Smyth, 2010). As discussed in earlier sections, EMA utilizes mobile electronic technologies to allow new ways for clinicians and researchers to intervene in the lives of their clients in real-time. Such an approach is especially favored among college students. Mobile applications provide students with a venue for mental health support in their hands, while protecting their confidentiality and anonymity. Such an approach has shown to be effective in reducing stigma, especially among students who are less likely to report their psychiatric symptoms or seek profession health. This Problem of Practice seeks an early prevention intervention design with the potential to reach whole student populations with mass delivery. The goal is to build a mental health

surveillance app that assesses students' psychological well-being in a natural context. Ecological momentary assessment is the perfect candidate for daily affect monitoring and reaching many students.

Another goal of this Problem of Practice is building resilience among students when they face distress in college years. It is impossible to eliminate stressors, but educators can help students cope, promote healthy living, and advance student success as whole people. Regular exercise shows mental health benefits for psychiatric and non-psychiatric populations alike. Results showing exercise alleviates depression have been especially robust (Dunn et al., 2005; Tordeurs, Janne, Appart, Zdanowicz, & Reynaert, 2011). Many suggest that a physically active lifestyle bolsters resilience against negative mood and emotions. Longitudinal studies suggest regular exercise protects against the onset of depression or recurrence of depressive symptoms (Schuch, Vasconcelos-Moreno, Borowsky, & Fleck, 2011). Supporting research shows exercise may lessen the magnitude and impact of stress response. Physiologically, physically fit individuals return to pre-stress levels quicker than non-fit individuals (Ströhle, 2009). Furthermore, physical activities could improve individual abilities to weather emotional stress (Ströhle, 2009).

This intervention aims to promote positive behavioral change and adaptive coping skills among college students. The research is interested in learning about the effectiveness of mood and emotion monitoring and using exercise promotion text messages through a smartphone app to change students' psychological well-being. As identified in the needs assessment, most stress, anxiety, and depression among students remains undealt with and hidden. EMA can potentially monitor students' mental health status to shine a light on students' mood and emotions, what their mental health needs are

on a daily basis, and support them as problems occur in real-time with 24/7 support in the palms of their hands.

The proposed intervention hopes to see two desired outcomes: lower stress, anxiety, and depression scores and increased physical activity levels among those in the intervention group compared to the control group. The minimal change to be observed as an outcome is that students in the intervention group would report better psychological well-being and higher fitness levels (measured by exercise time, strength, and frequency). The maximal magnitude of likely treatment outcome is students have better emotional responses to stressors as they perform more exercises. In other words, during stressful times, such as the midterm and final exam periods, their stress, anxiety, and depression scores are lower in the intervention group compared to control group.

Chapter Four: Intervention Procedure and Program Evaluation Methodology

Higher education has changed dramatically in the past several decades, placing more academic and financial stress on students (Guo, Wang, Johnson, & Diaz, 2011; Towbes & Cohen, 1996). Leaders have long acknowledged the current student mental health crisis (Carter et al., 2010). Students are not getting the help and support needed due to several underlying reasons such as stigma, inhibition, perceived need for care, and/or being unaware of available resources or how to access them (Eisenberg et al., 2009a; Eisenberg et al., 2007; Hunt & Eisenberg, 2010) Untreated symptoms then lead to development of mental illness and increased risk for suicide. Poor mental health negatively impacts student's academic performance (Richardson et al., 2012). Higher education institutions face challenges to improve services and support for students. The present goal to improve student mental health is bringing innovative interventions to advance services and support given to students.

Today's college student population is comprised of the millennial generation, individuals born between the early 1980s and the early 2000s (Howe & Strauss, 2003). Millennials are referred to as "digital natives," and they are the top smartphone users (Palmer, 2015). Recent advances in mental health technology offer a variety of multimedia interactivity and connectivity formats (Andersson & Cuijpers, 2009; Lintvedt et al., 2008). Self-help tools delivered on smartphone applications may be more easily embraced by the college-aged population than traditional approaches to mental health services (Mailey et al., 2010).

Past research has shown that EMA-based interventions make therapy a daily experience for clients with easy access to resources (Heron & Smyth, 2010). These

interventions provide a substitute for highly stressed and untreated students who do not speak up or seek for help, whether they fear of social stigma or have scheduling difficulties during a busy college career (Mailey et al., 2010; Ryan et al., 2010). Physical activity has been proven in past research as an adjuvant or alternative approach to treating mental disorders. Meta-analytic evidence shows participation in physical activity was effective in lowering depression and anxiety (Craft & Landers, 1998; Petruzzello et al., 1991). The current proposed intervention follows a student centered/technology-leveraged approach to monitor students' mood and emotions, and promotes physical activity to cope with distress.

The goals of this intervention are to monitor students' daily affect throughout the semester and to make campus mental health service more flexible, responsive, and accessible. To increase the efficacy, efficiency, and capacity of campus mental health services, technology-based interventions could reduce the demands for one-on-one sessions, group therapy, scheduling difficulties, stigma, and so on. Mass distribution of self-help tools such as exercise promotion via channels like smartphone apps and web-based services serve as preventive mechanisms with the ability to provide targeted improvements among students in distress or at risk for development of mental disorders.

Methods

Participants

This study design was a randomized controlled trial using convenient sampling method. Participants were undergraduate students between the ages of 18 and 24 who are enrolled in college and fluent in English. Participants needed to own an android or iOS smartphone to participate in the study. These devices were required to obtain the study

app. Study recruitment was done through email and flyers sent out by campus mental health services.

Variables and Measures

Demographics. At baseline, students are asked to report their gender, age, race, ethnicity, and class.

Depression, anxiety, and stress. The Depression Anxiety Stress Scales is a clinical assessment that measures the three related states of depression, anxiety, and stress (DASS-21; (Lovibond & Lovibond, 1995)). It has 21 questions and takes about three minutes to complete. DASS-21 was part of the baseline and follow up assessments. Depression, anxiety, and stress levels were the main outcomes of this study.

Daily affect measures. An important aspect of the current study was daily affect monitoring. The intervention monitors students' emotional well-being at three time-points in the semester. The goal was to inform administrators at which time-point the students' emotional well-being is at its worst throughout the semester. Six emotions are being assessed: cheerful, content, energetic, sad, fatigued, and anxious/worried. These cover a wide range of emotions that include both positive affect and negative affect.

Exercise frequency. Participants are asked whether they have exercised or not when they complete daily check-ins during data collection periods.

Procedure

The study was conducted using the LifeData (https://www.lifedatacorp.com/) company's RealLife Exp app for ecological momentary assessment (Runyan et al., 2013). At baseline, participants complete a brief questionnaire surveying demographics (age, gender, ethnicity, race, class, and year), depressive and anxious symptoms, and physical

fitness. The Depression Anxiety Stress Scales (Lovibond & Lovibond, 1995) captures depressive, physical, and psychological arousal or tension, agitation, and shows internal consistency and concurrent validity (Antony, Bieling, Cox, Enns, & Swinson, 1998). It yields three subscales: depression, anxiety, and stress.

Upon submission of the questionnaire, participants are automatically randomized to one of two groups (basic or augmented) and begin receiving question prompts and messages from the app. Questions are identical in terms of content and schedule for both groups. Participants receive question prompts at three time-points: beginning of the semester, around the midterm period, and before the final exam period. Each time-point consists of five days, with participants receiving five question prompts each day. Time points are approximately four weeks apart. Participants were sent two sets of questions in a randomized order with each prompt. First, they were asked to rate how much they felt six emotions (cheerful, content, energetic, sad, fatigued, anxious/worried) on a sliding scale (0 = not at all, 100 = extremely). Second, they were asked if they have exercised since the last time they responded to a prompt.

After the final five day data collection period, participants repeated DASS-21 and answered five broad impression questions: (1) How much did [the study] help you increase your exercise habits? (2) How much did [the study] help you maintain your exercise habits? (3) How much did you enjoy participating in [the study]? (4) Do you think exercising helps your mood? (5) Do you think exercising helps your general well-being?

Participants in the augmented group received additional messages throughout the study period. In addition to the self-monitoring protocol described above, participants in

this condition also received text messages explicitly reminding and encouraging them to exercise each week throughout the study period. Messages are designed based on social cognitive theory for behavioral change. Bandura (1986) suggested that self-regulation is an important source for behavioral change. Strategies included goal-setting, self-monitoring, implementation intentions (e.g. *"Come up with a precise step-by-step plan for exercising tomorrow. Be specific! Example: I will pack my gym clothes now. I will bring my bag to my history lecture tomorrow morning. When lecture ends at 11:30am, I will go straight to the gym, where I will bike for 45 minutes and watch a TV show.*"), scheduling, strategies for identifying and overcoming obstacles, resources, simple reminders, and encouragement (e.g. "*Start thinking about what motivates YOU to exercise. To have more energy? To focus and do better in school? To be more active? Tapping into this personal motivation is key.*"). Participants have access to resources via the app throughout the study period. Categories include facility hours, fitness class descriptions and schedules, information about personal trainers and gym tours, exercises for varying skill levels to do at home, strategies for overcoming commonly reported obstacles, and an activity log.

Statistical Analyses

Descriptive data for the enrolled sample will be presented as means with standard deviations for continuous variables and counts with proportions for categorical variables. An independent sample *t*-tests to assess group differences in age, depressive, anxious, and stress-related symptoms. Baseline fitness level and chi-square tests to assess whether gender, race, ethnicity, or class level differed by group assignment were conducted. Overall changes in exercise, mood, and anxiety from baseline to close of study were

tested with the repeated measures t-test. Repeated measures ANOVA and mixed ANOVA were conducted to examine group differences in these changes; the outcome variables were included as dependent variables, group assignment as the independent variable, and the appropriate baseline measure as a covariate.

Program Evaluation

Evaluation Question

Evaluation of the implementation of the current intervention focuses on how active students engage with the smartphone app. The following evaluation question was used: What is the participant's level of engagement with the app on a daily basis?

Definition of Fidelity of Implementation.

The entire intervention will be programmed and delivered to participants through a smartphone app. Fidelity of structure such as *adherence* and *exposure* is less of a concern than fidelity of process. More specifically *participant responsiveness* is the key consideration in defining the intervention's *fidelity of implementation* (FOI). A general definition of FOI for the current POP intervention is "active engagement of participants with the app on a daily basis." Their engagement can be further categorized into two components: completion of daily assessments and utilization of exercise promotion strategies.

Participants from both the basic and augmented groups were asked to accurately complete daily check-ins on their emotions and physical activity logs. An additional input for the treatment group is utilizing strategies provided for them to perform more physical activities. The aim of these inputs defined by the Theory of Treatment (Figure 2) is to help students monitor their mood and increase fitness levels, which leads to better mental

health. The outputs are changes in fitness levels measured by exercise frequency and changes in emotional scores (stress, anxiety, and depression) measured by the Depression Anxiety Stress Scales (DASS-21). During data collection periods, check-in questionnaires are promoted to all participants throughout the day. High fidelity of implementation is achieved when a participant completes majority of the reports and spends considerable time on each report. For example, there are five check-ins each day for five days within one data collection period, totaling 25 reports. Participants needed to complete at least 60% of these reports to stay in the program. In addition, the accuracy of their responses depends on "prompt response lapse" or how long it takes to complete each report. If a student only clicked through without reading and responding to the questions carefully, his/her prompt response lapse time is short, leading to low fidelity of implementation. This is a common threat to fidelity in self-reporting survey designs.

This intervention hopes to see two desired outcomes. The minimal change to be observed as an outcome is students in the augmented group would report higher fitness levels (measured by exercise frequency). The maximal magnitude of treatment outcome is students would have better emotional responses to stressors as they perform more exercises. In other words, during stressful times, such as the midterm and final exam periods, students in the augmented group would experience better daily affect and less stress, anxiety, and depression levels compared to those in the basic group.

Active engagement from the treatment group participants in utilizing strategies on how to be more physically active is crucial in examining experimental outcomes. Strategies can also be accessed voluntarily or through "user initiated sessions" (UIS). These include on-campus fitness classes and schedules, gym facility hours, exercise

instructions with pictures (outdoor and indoor), an activity log, gym tour and equipment orientation schedule, and strategies to overcome specific obstacles. Additionally, daily reminders, tips, and tricks that encourage exercise are prompted randomly (at least once per day) to students. These resources are intended to increase students' knowledge and awareness of exercise. Active engagement in utilizing provided resources leads to high fidelity. This occurs when a participant frequently accesses UIS and stays in randomly prompted sessions for a considerable amount of time, as they need to read the tips that require immediate actions. Such information is recorded as "session instance response lapse" and will be further discussed in the next section.

Indicators of Fidelity of Implementation

Five indicators of FOI are identified in Table 4.1. All five indicators will be recorded automatically by the smartphone app. They will be included in an excel spreadsheet when downloading the study data. Altogether, they measure participants' level of engagement with the intervention app daily.

Completion of daily assessments. An important input is daily check-ins for physical exercise and emotions. Participants are responsible for completing five check-ins per day during the three data collection periods, totaling up to 15 days. For each participant, the app back end platform tracks the number of reports he or she completed. From this tracking information, it is possible to generate a compliance score or "percentage of completed reports" for each participant. At the end of each data collection week, compliance scores will be generated for all participants. *They are asked to keep a 60% compliance score to stay in the program and to receive their incentives.*

Response elapse time. In addition to completing all reports, another important aspect of daily check-ins is completing them on time. As defined in the Logic Model (Figure 1), the app aims to help students to monitor their mood throughout the day. Five daily assessments are timely scattered from 9am to 9pm. Participants are expected to answer each assessment within 60 minutes of receiving them or else the prompt will expire. Short response elapse time indicates a participant completed the prompt right away upon receiving it, leading to high fidelity. Response elapse time is logged automatically for each assessment completed in the app platform.

Session elapse time on each assessment. Another important aspect of daily check-ins is honesty of participants. How truthful are their responses? Are they reading the questions carefully or just clicking through them? The outputs identified in the Theory of Treatment and Logic Model (changes in fitness levels and changes in emotional scores) heavily depend on the accuracy of responses. High fidelity requires careful completion of prompted assessments. The accuracy of reports will be measured by "Session Response Lapse," recorded automatically by the app and accessible from the app's back-end platform. If a participant did not pay attention to the questions and randomly selected answers, the response lapse time would be short. Assessments that last less than 30 seconds are considered low on fidelity.

Time spent on strategies prompted daily. Reminders, encouragement, and/or exercise tips and tricks were sent to the treatment group daily. Exercise promotion is an important input defined in ToT, and daily reminders are a key component of exercise promotion. They aim to increase students' knowledge and awareness of physical exercise and increase students' overall fitness level, which hopefully leads to reduced stress,

anxiety, and depression levels among students. This is also highly related to the outcome of the intervention: higher fitness levels among students and better emotional responses to stressors in the treatment group. When a participant receives an exercise promotion message, he/she is expected to read and utilize the strategies given in the message. For example, "*Making time for exercise happens when you see real value in it. How does exercise make you feel about yourself? Your abilities?*" To respond to this message, a participant needs to read it and think through their feelings about exercise. The elapsed time participants spend on a prompt (the time they keep it open) is an indicator of how well they engage themselves to put strategies into action. Again, this is recorded automatically by the app and available in data output. Longer elapse time indicates higher fidelity.

Frequency and elapse time of user initiated session. A second component of exercise promotion is User Initiated Sessions (UIS). It is as important as randomly prompted strategies in terms of carrying out ToT inputs and evaluating outcomes. UIS includes on campus fitness classes and schedules, campus gym facility hours, exercise instructions with pictures (outdoor and indoor), an activity log, gym tour and equipment orientation schedule, and strategies to overcome specific obstacles. Participants are encouraged to access these resources daily to gain more knowledge regarding exercise. Frequencies of accessing the UIS and the elapse time of each access serve as indicators for their level of engagement. These are recorded whenever a participant clicks into a UIS. In addition, whenever they access a session, time spent during that session will be recorded.

Outcome Evaluation

Research Questions

This randomized pilot trial examines three research questions:

1. *What is student psychological well-being like throughout the semester?*
2. *Do students who are more physically active have better psychological well-being than those who are less active?*
3. *Do students in the intervention group exercise more and have better psychological well-being?*

Objective

The objective of the present study is to examine the feasibility, acceptability, and preliminary efficacy of a smartphone-based physical activity intervention for undergraduate students and examine its effects on improving student mental health and promoting physical activity.

Hypotheses

It is hypothesized that students' psychological well-being, measured by the DASS-21 and six emotion measures, is at its worst at T3 before the final exam period. Participants with higher exercise frequency would have lower levels of depression, anxiety, and stress. Finally, participants randomized in the augmented group would have higher exercise frequency, better average mood, and lower levels of symptomatology in depression, anxiety, and stress.

Effect Size

The current study is a randomized controlled trial that focuses on comparing pre- and post-intervention effects on fitness level, anxiety, and depression among college

students among two independent samples (basic group versus augmented group). Selecting a minimum detectible effect size is based on the assessment of differential effects of experimental conditions on three variables: anxiety, depression, and physical activity change. A meta-analysis of anxiety outcomes from physical activity interventions found effect sizes ranging from 0.219 to 0.284 (Conn, 2010). From this meta-analysis, only one randomized study compared anxiety symptom outcomes between treatment and control groups and yielded an effect size of 0.219 (Conn, 2010). Analyses from eleven randomized studies testing the effects of exercise training interventions yielded a mean effect size of 0.94 (Ströhle, 2009). Mailey and colleagues (2010) studied an Internet-delivered physical activity intervention for college studies with mental health disorders. Results indicated a larger increase in physical activity in the intervention condition (d = 0.68) than the control condition (d = 0.05).

Each of the three measurable outcomes—anxiety, depression, and physical activity change—has a different minimum effect size based on past research, d = 0.219, 0.94, 0.68 respectively. To achieve significance for all three variables, 0.94 is picked as the minimum effect size for the current study and for sample size calculation. A power analysis was conducted using G*Power. Based on a two-sample t-test with an effect size of 0.94, a standard alpha of 0.05, and a strong power of 0.95, the number of subjects required for the study to have sufficient power to detect the effect of the intervention is 62. Thirty-one individuals need to be randomized into each intervention and control condition. This number is highly feasible based on a pilot study of the current intervention ran this semester. If sample size drops for the actual experimentation, a

minimum of 38 subjects, 19 in each group, is needed to achieve an effect size of 0.94, a standard alpha of 0.05, and a moderate power of 0.80.

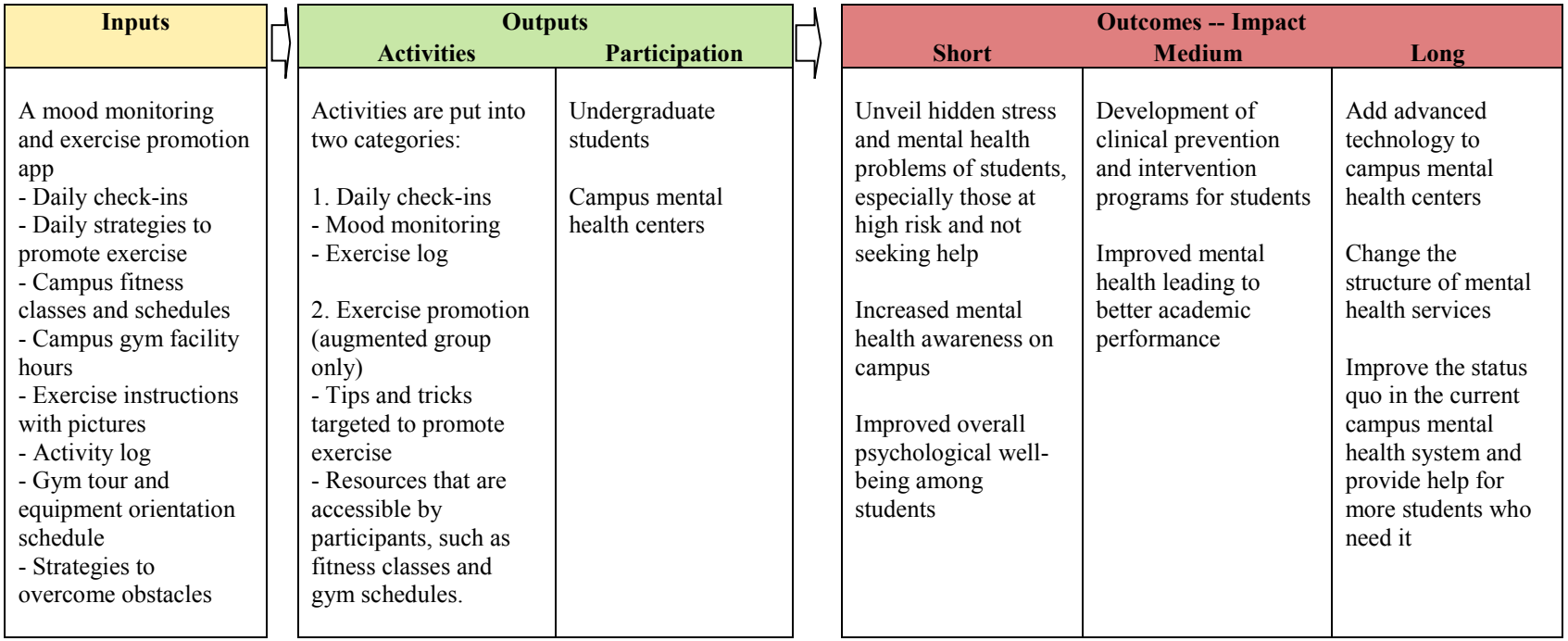

Figure 1. Logic model for the intervention

The problem: increasing depression, anxiety, and stress levels observed among college students
The treatment: a mood monitoring and exercise promotion smartphone application

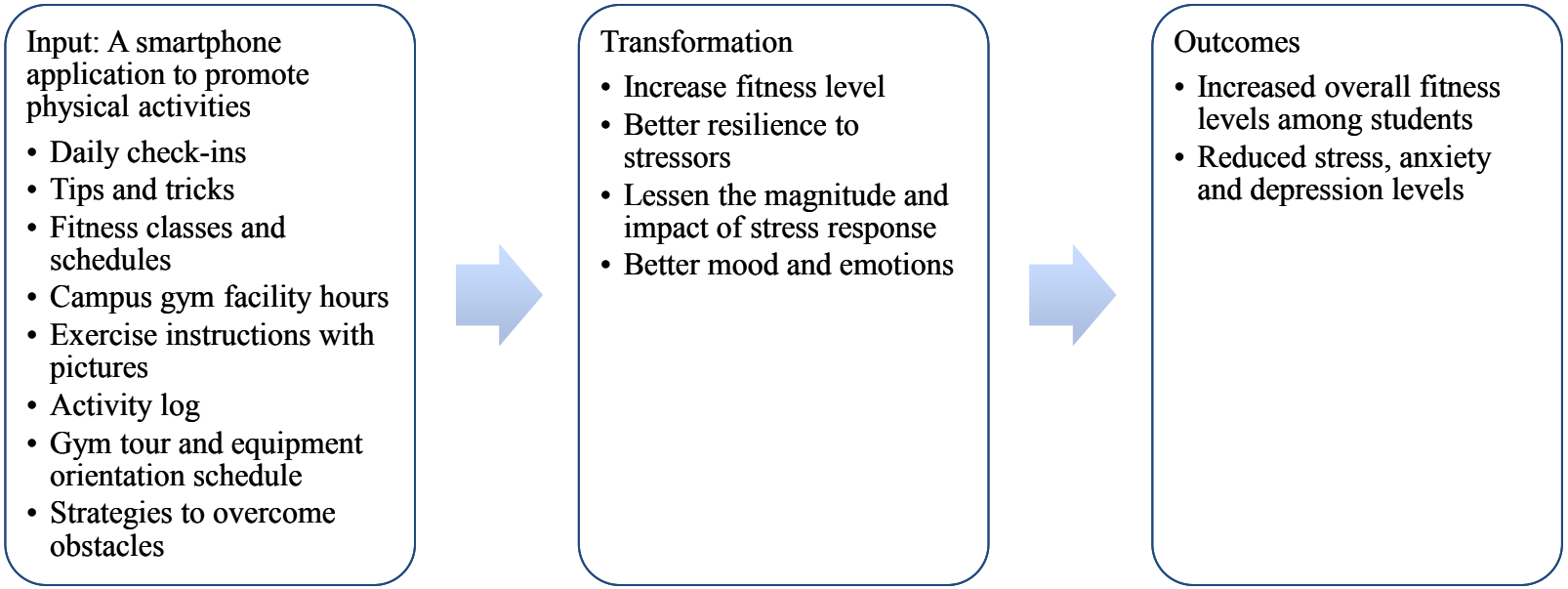

Figure 2. Theory of Treatment: A Casual Model

Table 4.1

Data Collection Matrix for Five Indicators of Fidelity of Implementation

Fidelity Indicators	Data Sources/Data Collection Tool	Frequency	Responsibility
Completion of Daily Check-ins	Recorded automatically by the app and available in data output	Check-in reports are sent to participants daily in three data collection weeks. A compliance score is calculated for each week. At the end of the study, a compliance score of daily check-ins is calculated for each participant	Participants are responsible to complete five check-in reports per day over three data collection weeks totaling up to 15 days. Participants need to complete at least 60% of the reports to stay in the program.
Response Elapse Time	Recorded automatically by the app and available in data output	These are recorded automatically for each assessment completed.	Participants are expected to answer each check-in report within 60 minutes of receiving it.
Session Elapse Time on Each Check-in	Recorded automatically by the app and available in data output	These are recorded automatically for each assessment completed.	Participants are expected to read each question carefully and respond truthfully within a considerable time frame. Session elapse times are expected to be longer than 30 seconds for each report.
Time Spent on Prompted Strategies	Recorded automatically by the app and available in data output	Recorded whenever a reminder/encouragement/tip/trick message is prompted.	Participants are expected to read and utilize the prompted strategies. Time spent on each strategy is an indication of their effort putting strategies into action.
Frequency and Elapse Time of User Initiated Sessions	Recorded automatically by the app and available in data output	These are recorded whenever participants access exercise resources provided for them. Whenever they access a session, time spent during that session will be recorded.	Participants are encouraged to access resources provided to them on the app such as fitness class schedules and indoor exercise lists. Time and frequency serve as indicators of how much they utilize the provided resources.

Table 4.2

Data Collection Matrix for Evaluation

Indicator	Role of Indicator	Data Source	Frequency	Responsibility
Experimental condition Basic vs. Augmented	Control variable	Random assignment of participant upon submission of baseline questionnaire	Once, at the beginning of the study	Participants are randomly assigned into one of the conditions
Fitness level	Outcome variable	Exercise frequency	Daily	Participants report through check-in prompts sent via smartphone app
Depression, anxiety, and stress	Outcome variables	Depression Anxiety Stress Scales (DASS-21)	Twice, at baseline and follow up	Participants report through baseline questionnaire and follow up questionnaire
Daily affect		Mood-monitoring prompts	Daily	Participants report through check-in prompts sent via smartphone app
Demographics: Age, gender, class, race	Confounding variables	Baseline questionnaire	Once, at the beginning of the study	Participants report through baseline questionnaire

Chapter Five: Intervention Findings

Process of Implementation

The study was conducted using the LifeData (https://www.lifedatacorp.com/) company's RealLife Exp app for ecological momentary assessment (Runyan et al., 2013). At baseline, participants completed a brief questionnaire surveying demographics (age, sex, ethnicity, race, class year) and baseline psychological symptoms. The Depression Anxiety Stress Scales (Lovibond & Lovibond, 1995) captures depressive, physical, and psychological arousal or tension, agitation, and shows internal consistency and concurrent validity (Antony et al., 1998). It yields three subscales: depression, anxiety, and stress.

Upon submission of the questionnaire, participants were automatically randomized to one of two groups (basic or augmented) and began receiving question prompts and messages from the app. Questions were identical in terms of content and schedule for both groups. At three time-points (beginning of the semester, around the midterm period, and final exam week) during the study period, participants received question prompts. Each time-point consisted of five days with participants receiving five question prompts each day. Time points were approximately four weeks apart. Participants were sent three questions in a randomized order with each prompt. First, participants were asked to rate how much they felt six emotions (cheerful, content, energetic, sad, fatigued, fearful) on a sliding scale (0 = not at all, 100 = extremely). Second, they were asked if they had exercised since the last time they responded to a prompt (this did not include walking to class, work, social events, or errands).

After the final five-day data collection period, participants repeated the DASS-21 and answered five broad impression questions: (1) How much did [the study] help you increase your exercise habits? (2) How much did [the study] help you maintain your exercise habits? (3) How much did you enjoy participating in [the study]? (4) Do you think exercising helps your mood? (5) Do you think exercising helps your general well-being?

Participants in the augmented group received additional messages throughout the study period. In addition to the self-monitoring protocol described above, participants in this condition also received text messages explicitly reminding and encouraging them to exercise each week throughout the study period. Messages included goal-setting, implementation intentions (e.g. *"Come up with a precise step-by-step plan for exercising tomorrow. Be specific! Example: I will pack my gym clothes now. I will bring my bag to the history lecture tomorrow morning. When the lecture ends at 11:30am I will go straight to the gym, where I will bike for 45 minutes and watch a TV show.*"), scheduling, strategies for identifying and overcoming obstacles, resources, simple reminders, and encouragement (e.g. "*Start thinking about what motivates YOU to exercise. To have more energy? To focus and do better in school? To be more active? Tapping into this personal motivation is key.*"). Participants had access to resources via the app throughout the study period. Categories included facility hours, fitness class descriptions and schedules, information about personal trainers and gym tours, exercises for varying skill levels to do at home, strategies to overcome commonly reported obstacles, and an activity log.

Statistical Analyses

Descriptive data for the enrolled sample are presented as means with standard deviations for continuous variables and counts with proportions for categorical variables (Table 5.1). Independent sample *t*-tests were conducted to assess group differences in age, and baseline depressive, anxious, and stress-related symptoms. Chi-square tests were conducted to assess whether gender, race, ethnicity, or class level differed by group assignment. The overall intervention effect and changes in exercise, daily affect, and the three symptom measures were tested with two sample t test, repeated measures ANOVA and mixed ANOVA. A multiple linear regression analysis was conducted to test exercise as a predictor on students' psychological well-being measured by the three DASS subscales.

Findings

Participants

Eighty participants (57 women, 23 men, M_{age} = 19.81 years, *SD* = 1.24, age range: 18-22) enrolled in the study. Eligible participants were current undergraduates in a Northeastern private college, at least 18 years of age, and fluent in English. Participants were excluded if they reported no regular exercise (defined as less than one hour per week of at least moderate exercise) and denied any interest or intention in becoming more physically active. Forty-one participants completed the study and had a compliance score of 60 or higher. Baseline measures and demographic characteristics of the participants are presented in Table 5.1 Participants who did not complete the study or scored lower than 60 in compliance were excluded from analysis. The ethnic/racial composition of the final sample was 43.90% Caucasian, 7.32% African American, 44.46% Asian or Asian American, 7.32% multiracial and two (4.88%) participants identified themselves as Hispanic or Latino. The Committee on the Use of Human Subjects approved the study protocol, and participants provided informed consent prior to initiation of any study procedure. Chi-square tests showed there were no group differences in gender, race, ethnicity, or class level between basic

and augmented groups. Results from two sample t tests showed there were no group differences in age or depressive, anxious, and stress symptoms (Table 5.1).

Table 5.1

Demographic and Baseline Characteristics

	Whole Sample N (%)	Basic Group N (%)	Augmented Group N (%)	*p*
Gender				.39
Female	33 (80.5)	18 (85.7)	15 (75.0)	
Male	8 (19.5)	3 (14.3)	5 (25.0)	
Race				.39
Caucasian	18 (43.9)	11 (52.4)	7 (35.0)	
Black/African	3 (7.3)	2 (9.5)	1 (5.0)	
American	17 (41.5)	6 (28.6)	11(55.0)	
Asian/Asian	3 (7.3)	2 (9.5)	1 (5.0)	
American				
Multiracial				
Ethnicity				.97
Hispanic/Latino	2 (4.9)	1 (4.8)	1 (5.0)	
Not Hispanic/Latino	39 (95.1)	20 (95.2)	19 (95.0)	
Class				.40
Freshman	17 (41.5)	7 (33.3)	10 (50.0)	
Sophomore	9 (22.0)	6 (28.6)	3 (15.0)	
Junior	5 (12.2)	3 (14.3)	2 (10.0)	
Senior	10 (24.4)	5 (23.8)	5 (25.0)	

	Whole Sample Mean ± SD	Basic Group Mean ± SD	Augmented Group Mean ± SD	*p*
Age	19.78 ± 1.31	19.71 ± 1.23	19.85 ± 1.42	.26
Pre DASS-Depression	19.76 ± 5.70	18.38 ± 4.88	21.20 ± 6.24	.27
Pre DASS-Anxiety	18.78 ± 4.54	17.90 ± 4.27	19.70 ± 4.74	.85
Pre DASS-Stress	22.88 ± 7.54	21.43 ± 6.36	24.40 ± 8.50	.20
Compliance	79.25 ± 9.19	78.54 ± 8.50	80.0 ± 8.51	.42

Compliance. The current study had a retention rate of 51%. Participants who did not complete the study or had a compliance rate of less than 60 were considered dropouts. Forty-one participants completed the study and scored 60 or higher. Average compliance percentage for the final sample ($N = 41$) is 79.25 ± 9.19, equivalent to approximate completion of a total of 59 prompts on average out of the 75 prompts sent. Two sample t

tests were conducted to test if compliance scores differed between the two groups, and no significant difference was found (Table 5.1). Among participants in the augmented group, students spent approximately 1 minute and 30 seconds on average on each strategy prompted to them.

A two-sample t test was conducted to examine any differences in baseline DASS symptom levels between dropouts versus the final sample ($N = 41$). Depression and stress scores were identical between the two groups ($ps > .05$). However, on average, dropouts had significantly higher anxiety levels ($p = .035$). Higher anxiety may be a contributing factor to stopping the study, which will be discussed later in this chapter.

Research Question One

Participants' depression, anxiety and stress scores were highest at the beginning of the semester (Table 5.2). The scores in all three symptoms significantly decreased by the end of the study. Interaction between depression, anxiety, or stress with group (prepost*Group) was not significant (Table 5.2). In terms of the six emotion and mood scales, no significant changes were found in any of the six emotions at T1, T2, versus T3 (Table 5.3). There were not any group interactions (emotion*Group) found in any of the six emotions throughout the semester.

Table 5.2

Mixed ANOVA Analysis Comparing DASS Depression, Anxiety, and Stress Scores at Baseline versus Follow-up by Group (N = 41)

	Baseline		Follow up		Main effect *p*-value	Interaction *p*-value
	Basic	Augmented	Basic	Augmented		
Depression	18.38±4.88	21.20±6.24	4.00±5.74	7.22±6.59	.00	.96
Anxiety	17.90±4.27	19.70±4.74	4.22±4.99	5.11±4.96	.00	.48
Stress	21.43±6.36	24.40±8.50	8.44±6.64	10.44±7.47	.00	.76

Table 5.3

Mixed ANOVA Analysis Comparing Emotion Scores at T1, T2 and T3 by Group (N = 41)

	Main effect *p*-value (T1, T2, vs. T3)	Interaction *p*-value (*Group)
Cheerful	.16	.22
Content	.24	.29
Energetic	.34	.35
Sad	.99	.62
Fatigued	.20	.11
Fearful	.87	.59

Research Question Two

A multiple linear regression analysis was conducted using exercise frequency as a predictor of the three psychological symptoms while controlling for group, age, sex, and class. Exercise frequency did not predict depression (t = -.06, p = .95) or anxiety (t = 1.70, p = .11) at follow up. Exercise frequency was a significant predictor of stress while controlling for group, age, sex, and class (t = 2.09, p = 0.05). However, the overall regression model was just shy of significance (F = 2.25, p = 0.07). An additional model was run without the potential confounding variables (group, age, sex, and class). Exercise frequency was no longer a significant predictor (t = 1.82, p = 0.08).

An additional multiple linear regression analysis was conducted using exercise frequency as a predictor of change in depression, anxiety and stress while controlling for group, age, sex, and class. None of the models or independent variables were significant (*ps* > .05).

Research Question Three

Participants from the basic group and augmented group did not differ in their exercise behaviors (Table 5.4). On average, participants from the intervention group exercised 6.33 times during the 15 experimental days and participants from the control group exercised 5.95 times ($p = .80$). The two groups also did not differ in pre- and post-DASS measures (Table 5.1 and Table 5.2). However, as discussed earlier, both groups had significantly decreased symptom scores in depression, anxiety, and stress at post study follow up.

Table 5.4

Two Sample t test Comparing Exercise Frequency

	Basic Group	Augmented Group	*p*
T1	1.86 ± 1.93	1.90 ± 1.77	.94
T2	2.10 ± 2.17	1.95 ± 2.11	.83
T3	2.00 ± 1.67	2.44 ±2.01	.46
Whole study period	5.95 ± 4.66	6.33 ± 4.74	.80

Conclusion

The current study explored the feasibility, acceptability, and preliminary efficacy of a mood monitoring application and text message intervention to encourage physical activity in a sample of college students ($N = 41$). Students' mood and emotions were found to be more positive towards the end of the semester. Though participants showed

significant improvements in depressive, anxious, and stress symptoms at follow up compared to baseline, these changes did not differ between the basic and augmented groups (*ps* > .05). Furthermore, neither group reported increased exercise frequency on average ($p = .58$). There was not a significant relationship between exercise and the three psychological measures (depression, anxiety, and stress). Exercise frequency was just shy of significance in predicting stress level ($t = 1.82$, $p = 0.08$). The findings suggest that mood monitoring and a text message intervention for exercise promotion are feasible and acceptable among college students. However, more work is needed to identify more effective content in promoting physical activity. Implications of the current findings, limitations, modifications, and future research directions will be discussed in the next section.

Discussion

The findings of this pilot intervention study showed promising results in using smartphone applications in mental health promotion on college campuses. Students were generally interested in participating in the study. The final sample had high compliance on average. The study was successful in monitoring students' daily affect throughout the semester. The current study did not find a significant correlation between physical activity and depression, anxiety, or stress. Although there were no intervention effects on exercise promotion or psychological well-being, the sample as a whole had a significant decrease in depressive, anxious, and stress symptoms at the end of the study.

Introducing Technology in Campus Mental Health Services

One goal of this study is to explore the feasibility and acceptability of using technology targeted at increasing capacity and delivery channels of mental health

services service and support on college campuses. There is a substantial increase in the number of students seeking help for mental health problems in the past decade, and campus mental health and counseling centers face challenges improving and expanding services to meet student's needs (Watkins et al., 2012). The results of this study have shown that building mental health smartphone apps can be a potential solution. Eighty students were initially enrolled in the study and completed the baseline questionnaire. Seventy-six students downloaded the study app and forty-one completed the study with compliance scores of 60 or higher. Students completed assessments and daily affect prompts entirely on their phones without coming in to the lab. In response to the end of study impression question, most participants indicated they enjoyed participating in the study. For example, one participant indicated, *"I became more aware of how much exercise does to regulate and improve my mood!"*

The results found that students who dropped out or had low compliance rate with the study had significantly higher anxiety levels on average than those in the final sample. Significant difference was not found in depression or stress between dropouts/low compliances versus the final sample. Highly anxious individuals were more likely to stop using the app than those who had lower anxiety. In the past, it has been found that people with anxiety disorders have higher treatment dropout rate than other psychiatric disorders (Santana & Fontenelle, 2011). It is reasonable to assume the mood monitoring questions may provoke anxiety in some individuals, leading them to drop out of the study. Additionally, when individuals feel anxious, they also experience concentration problems, making normal tasks seem hard to focus on.

Students' Psychological Well-being Throughout the Semester

Students' daily affect was assessed at three time-points: at the beginning of the semester (T1), around the midterm period (T2), and at the end of the semester just before final exams (T3). Students' daily affect was stable at the three time-points. Such results came as a surprise and contradicted the hypothesis. May happens to be the most stressful month of the year for college students. Finals week intensifies the academic pressure many feel throughout the year. Although students' daily affect measures were not significantly statistically different across the three time-points, it was expected that negative emotions would be the highest around final exam period. The current findings did not yield such phenomenon.

One major finding of the study is that the sample as a whole showed a significant decrease in depression, anxiety, and stress levels at post-study follow up compared to the baseline assessment. As illustrated in Table 5.2, on average, participants had a decline in all three symptom subscales by more than 50%. Although exercise as an intervention did not show an effect in this study, mood monitoring and the daily assessment prompts sent to participants might potentially explain the daily affect change and decline in psychological symptoms. In other words, mood monitoring might be an intervention itself, explained by the concept of *mindfulness* and its role in psychological well-being.

Mindfulness is defined as a state of being attentive to and aware of what is happening to oneself (Brown & Ryan, 2003). Many psychological research and theories support the importance of the quality of such consciousness for the maintenance and enhancement of well-being (Brown & Ryan, 2003). Ryan and Deci (2000) argue that mindfulness helps individuals disengage from automatic thoughts, habits, and unhealthy

behavior patterns. Through these psychological processes, mindfulness could play a key role in fostering informed emotional and behavioral regulation (Ryan & Deci, 2000). When students answered daily affect prompts (e.g. "On a scale from 1 to 100, how cheerful are you feeling right now?"), they became aware of their mood and emotions at that moment. Such open awareness may facilitate their well-being through self-regulated activity and fulfillment according to their needs. For example, if a participant was assessed and realized he was anxious, the student would be more attentive and regulate his/her anxiety with coping skills such as listening to music or watch a movie.

The potential effectiveness of mood monitoring to students' psychological well-being has significant implications in campus mental health practices. Lack of mental health awareness is one of the main contributors to campus mental health support (Gruttadaro & Crudo, 2012). Students were not aware of psychiatric symptoms, therefore, when they experience heightened anxiety or depression, they did not know coping skills or to seek professional help. It is important for students to first understand their own susceptibility to mental health issues. Knowing feelings of stress, isolation, homesickness, and heartbreak and how one handles stress, depression, or anxiety, may help students realize when they are becoming ill. Assessments delivered through smartphone applications act as surveillance, which raises mental health awareness and offers a massive delivery of support for students. The concept of a mental health tracking app has the potential to enhance counseling services with mobile technology and convenience.

Intervention Effects, Physical Activity, and Psychological Well-being

Although, on average, the augmented group exercised slightly more than the basic group, such difference was not statistically significant. Given that the hypothesis of

exercise promotion failed, the two groups did not differ in DASS measures or daily affects. Current results did not find a significant relationship between PA and student's psychological well-being. This is inconsistent with findings in the literature (Mailey et al., 2010). Stress was the only dependent variable that almost yielded significance ($p = 0.07$). Measurement of physical activity was done through self-report, while previous research utilized more advanced physical measurements for PA. For example, Mailey and colleagues (2010) used an accelerometer that measures and records acceleration. Many factors of PA should be accounted for when correlating it with psychological measures. For example, type of exercise (aerobic or anaerobic), length of exercise, intensity, and one's personal physical response to exercise should be accounted for. One participant suggested that most of her exercise came from "walking around campus all day, 4-8 miles." The daily assessments did not capture such exercise. The most accurate way to measure PA is with wearable devices (e.g. Fitbit or Apple Watch). Due to funding limitations, the current study lacked such resources. The relationship between PA and students' psychological well-being was not accurately found.

Limitations

Some limitations exist in this study that may affect the results and interpretation of findings. The biggest limitation is sampling/selection bias. This research had a small sample size ($N = 41$) and used a convenience sampling procedure. Participants were recruited from a single institution, thus decreasing the generalizability of findings. In addition, course credits were awarded as incentives to participants. Although the target population was all undergraduates at the school, students who were most likely to participate were those who needed study/course credits required by the classes they were

taking. These courses were mostly psychology, brain sciences, and sociology classes. The sample selection was not representative of the entire undergraduate population. Social science students, especially those majoring in psychology, might possess certain characteristics distinguishing them from the other students.

Another limitation is the need to rely on self-reports collected from participants. The self-report study design suffers from several issues. First, this limitation includes the requirement that the honesty of the participants is assumed. Reliable results would need participants to respond honestly to each question. In addition, the unreliability of measures may lead participants to interpret questions differently. Most of the questions from the current study design are based on rating scales (e.g. 1-100). Students might present variability in conceptualizing the scales. For example, participants who respond "20" on the same question may interpret the meanings of the scale points differently. Missing data is another issue with the current study design. Lastly, measurement of physical activity using self-reported frequency alone could not accurately capture a participant's physical activity levels. More sophisticated measurements, such as sensors or wearable devices, should be utilized to yield more precise results.

The study collected data for one semester. Students' psychological well-being may change based on whether it is fall semester or spring semester. Results were only based on data collected during a spring semester. The location of the sampling institution has severe weather changes from fall to spring semester. Experimentation during a full school year may reflect more accurate results.

Finally, one major finding of the study is the effectiveness of mood monitoring in lowering depression, anxiety, and stress symptoms. However, a control group confirming

such effect is lacking because this was not the main intervention under investigation. Future research should add a control group that receives no assessments to test mood monitoring as a means to cope with mood disturbance and stress and to promote students' psychological well-being.

Finally, the study did not find any intervention effect on exercise promotion. It was difficult to evaluate how much of the intervention was taken into action. Exercise promotion text messages were sent to participants. On average, participants reviewed these messages for about one and half minutes. However, it was unclear if participants took an action on the strategies prompted to them. The whole study was done remotely, and there were no in-person interactions with the participants. Additional face-to-face sessions may need to be added to maximize user engagement, and to obtain user feedback and reasons for dropout.

Future Directions

Technology has opened a new frontier in campus mental health support. It gives practitioners and researchers new ways to monitor and understand mental well-being. As a pilot trial, this study's research framework and methodology have shown great potential in addressing mental health issues on college campuses using mobile technology. Future research should expand over multiple institutions and increase the sample size in recruitment. To increase compliance rates and participant engagement, the intervention may be integrated into the university support system or current mental health services. Implementation of any new intervention in higher education is impossible without institutional support. With support from the leadership team, there is great potential to develop full-service campus mental health applications that include more tools and

resources tailored to who the app will serve. Future research should advance content development, potentially leading to a full-service mental health application that promotes positive mental health and well-being throughout the student body.

There are also potential design and methodology improvements to be made. Physical activity should be more carefully measured and scored, like using wearable acceleration sensors attached to one's body. The effect of mood monitoring came out prominent in the current study results. Such an effect should be carefully investigated in future research by adding a control group. Furthermore, more recent research articles have suggested advanced and complex statistical analyses for ecological momentary assessment study data. Appropriate statistical methods should be reviewed and may be applied to the current datasets to reveal more interesting results.

Finally, although the study was successful in obtaining data from participants entirely online, a few in-person sessions may increase user engagement and could be used obtain additional information from participants. It was unclear if participants in the augmented group actually implemented the tips and tricks presented in the exercise promotion text messages. In addition, the reasons participants dropped out of the study were unknown. Future research should improve the current design and have a few in-person group sessions throughout the study to receive feedback and maximize participant engagement.

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Biographical Sketch

Gwyneth Wu was born in Hebei, China. She received her Honours Bachelor of Science from University of Toronto and master's in clinical psychology from Harvard University. Her past research focuses on etiology, prevention, and treatment of psychiatric illnesses—posttraumatic stress disorder, social anxiety disorder, and depression. She has worked on multiple large-scaled clinical trials in the field of psychiatry at Massachusetts General Hospital, Harvard University, and University of California, San Francisco.

Gwyneth is passionately committed to academic research and teaching. She was a head teaching fellow for several statistics and research methods classes at Harvard University for four years and was appointed as an adjunct faculty at Simmons College for a year. She was a Project Director at the Disparities Research Unit, Massachusetts General Hospital/Harvard Medical School working on a PCORI-funded clinical trial that examines the effectiveness of a behavioral health patient/provider intervention, specifically for patients of color. In 2017, she moved to San Francisco and was hired as a project lead for a clinical research project, funded by the US Army and Department of Defense, investigating biological markers for Posttraumatic Stress Disorder (PTSD) with the goal of discovering novel treatments and diagnostic tools.

Gwyneth has presented numerous papers at professional organizations and conferences. She authored peer-reviewed and non-refereed articles that were cited over 100 times in the literature. Her career goal is to become a part of the next generation of academic researchers and leaders in higher education.